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SOME HOMOPTERA FROM THE CAROLINE ISLANDS[1]

By Z. P. Metcalf

North Carolina State College, Raleigh, North Carolina

Plates 1–3

The present paper is the result of the study of a collection sent to me by Dr. T. Esaki, Entomological Laboratory, Department of Agriculture, Kyushu University, Fukuoka, Japan. In addition there has been a small amount of material from other collections. Notable contributions to our knowledge of the Homoptera have been made through the study of some of the Pacific Islands, especially the Hawaiian Islands, Samoan Islands, and Fiji Islands, but many of the small islands have not been studied extensively; therefore, any contribution to the fauna of this great region is helpful in studying the zoogeographic development of this area and also for the study of the biology and taxonomy of the group.

cixiidae Family cixiinae Subfamily cixiini Tribe

Oliarus Stål

In the number of described species, this is one of the largest genera in the fulgorids. Giffard (1925) gives keys to and descriptions of the species from the Hawaiian Islands. This includes a total of fifty-two species, all of which are assigned to the subgenus *Nesoliarus* except four previously described species which are not assigned by Giffard. A large number of species are known from India, a considerable number from southeast Asia and China, a large number from Japan, the East Indies, and Australia, only one from New Guinea, several from the Pacific Coast States, a few from Western Mexico and from Central America, but so far as I can discover, no species have been recorded from the west coast of South America. There is a single species recorded from the Galapagos Islands. Outside of the Hawaiian Islands which have already been referred to, only six species have been recorded from all of the Pacific islands. Five of these come from Fiji and one from the Marquesas Islands. There are two females in the present collection from Ponape which I describe as a new species in order to call it to the attention of others so that they may describe the males and thus define the species more completely.

[1] Contribution from the Entomology Department, North Carolina Agricultural Experiment Station, Raleigh, North Carolina. Published with the approval of the Director of Research as Paper No. 535 of the Journal Series.

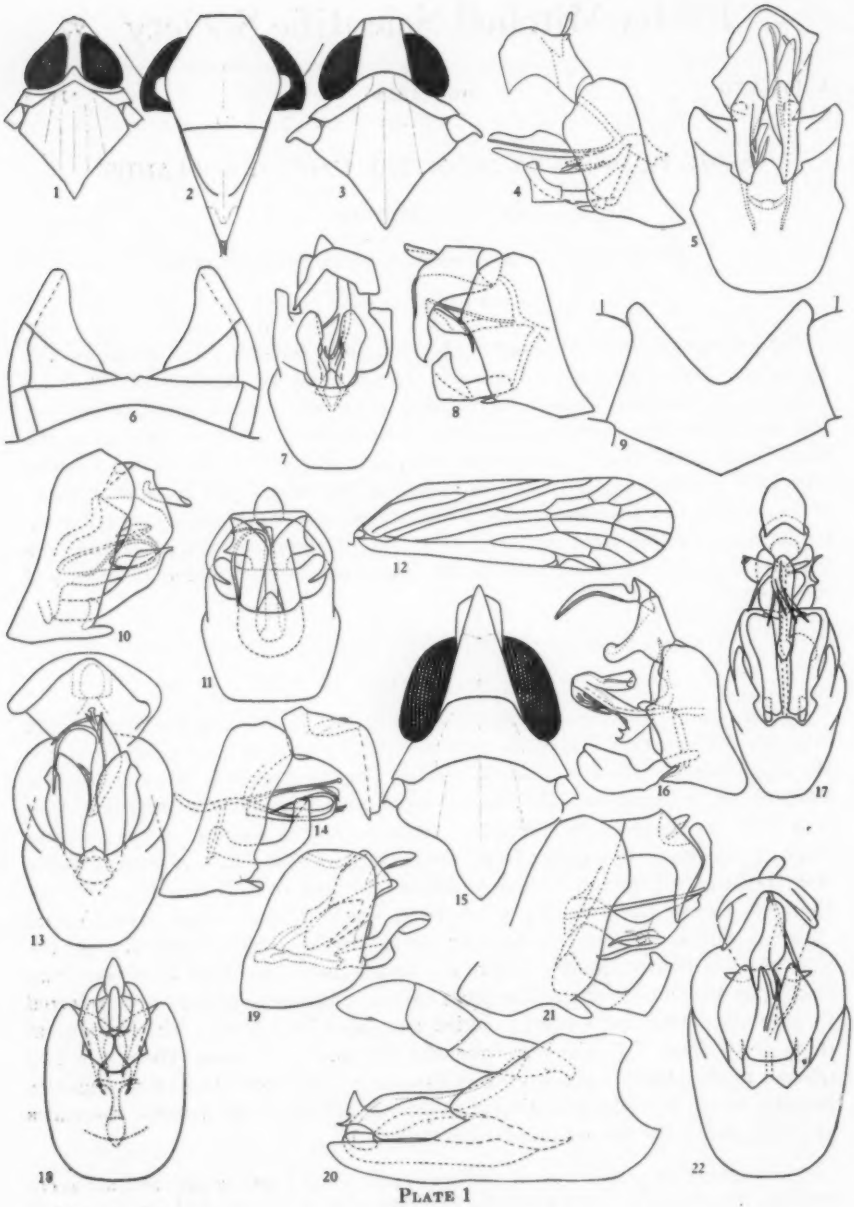

PLATE 1

Oliarus carolinensis sp. n. (Pl. 1, Fig. 1)

This is a rather small robust species with a narrow, elongate vertex. Typically the body is chiefly blackish fuscous; the tegmina are translucent, clouded with yellowish fuscous or blackish fuscous on the apical cells.

Head narrow; vertex narrow, elongate, nearly three times as long as its greatest width, lateral margins strongly elevate, carinate; lateral areolets narrow, elongate, almost half as long as the vertex; frons narrow dorsally, lateral margins rather strongly widened to below the antennae and then slightly narrowed to the clypeus; lateral margins carinate, median carina distinct, forked dorsally to make a small median areolet about twice as long as broad; median ocellus small; clypeus deeply inserted in the frons, median and lateral carinae distinct; anteclypeus with a strong median carina. Pronotum rather short, posterior margin deeply incised, median carina strongly elevated, lateral carinae strongly curved reaching the ventral lateral carinae of the pronotum. Mesonotum typical, carinae strongly elevated.

General color fuscous to blackish fuscous; carinae and most of the pronotum ochraceous; tegmina and wings translucent, veins chiefly ochraceous before the apical cells; pustules minute, veins set with short, slender setae; nodal cell and apical cells of the tegmina and wings in the darker colored specimens clouded with fuscous; venter chiefly fuscous with legs and genital segments ochraceous.

Length to apex of tegmina 6.4 mm.

Holotype: Female, Ponape Island, 18 Jan. 1938. Paratype: Female, Ponape Island, 8 Jan. 1938.

Myndorus gen. n.

Orthotype *Myndorus apicalis* sp. n.

Head slightly narrower than the pronotum; vertex somewhat longer than broad, lateral margins nearly straight, somewhat flaring posteriorly, anterior margin carinate, nearly straight or broadly triangularly produced on the median line, posterior margin shallowly, circularly incised, no median carina; frons longer than broad, dorsal margin nearly straight, narrower than the clypeal suture;

PLATE 1

FIG. 1. *Oliarus carolinensis* n. sp. Dorsal view of head and thorax.

FIGS. 2–6. *Myndorus apicalis* n. sp. FIG. 2. Facial view. FIG. 3. Dorsal view of head and thorax. FIG. 4. Lateral view of ♂ genitalia. FIG. 5. Ventral view of ♂ genitalia. FIG. 6. Last abdominal segment of ♀.

FIGS. 7–9. *Myndorus fusciterminalis* n. sp. FIG. 7. Ventral view of ♂ genitalia. FIG. 8. Lateral view of ♂ genitalia. FIG. 9. Last ventral segment of ♀.

FIGS. 10–12. *Myndorus marginatus* n. sp. FIG. 10. Lateral view of ♂ genitalia. FIG. 11. Ventral view of ♂ genitalia. FIG. 12. Venation of tegmen.

FIGS. 13–14. *Myndorus niger* n. sp. FIG. 13. Ventral view of ♂ genitalia. FIG. 14. Lateral view of ♂ genitalia.

FIGS. 15, 18–19. *Stenocranus carolinensis* n. sp. FIG. 15. Dorsal view of head and thorax. FIG. 18. Ventral view of ♂ genitalia. FIG. 19. Lateral view of ♂ genitalia.

FIGS. 16–17. *Myndorus palescens* n. sp. FIG. 16. Lateral view of ♂ genitalia. FIG. 17. Ventral view of ♂ genitalia.

FIG. 20. *Lallemandana spinifera* n. sp. Lateral view of ♂ genitalia.

FIGS. 21–22. *Myndorus uniformis* n. sp. FIG. 21. Lateral view of ♂ genitalia. FIG. 22. Ventral view of ♂ genitalia.

lateral margins carinate, gradually expanded to the level of the antennae and then rounding to the clypeal suture; median carina distinct on the dorsal three-fourths, indistinct or wanting ventrally; median ocellus indistinct; postclypeus with distinct lateral and median carinae; antennae short. Pronotum short and broad, deeply triangularly incised posteriorly; no median carina; intermediate carinae reaching the posterior border; a single lateral carina. Mesonotum with three carinae. Tegmina with the veins indistinctly granulate and with short setae; radius and subcosta united to near the middle of the tegmina; radius with two simple branches; media contiguous to the stem of subcosta-radius near the basal cell; media with five distinct branches; cubitus branching beyond the branching of subcosta-radius. Hind tibiae rather long, without spines.

Myndorus apicalis sp. n. (Pl. 1, Figs. 2–6)

This is an ochraceous species with the pronotum fuscous and distinct genitalia.

General color of the head ochraceous, eyes brownish, heavily spotted with black; frons ochraceous, indistinctly and irregularly clouded with fuscous; postclypeus clouded with fuscous on the dorsal third; pronotum chiefly fuscous with the posterior border narrowly ochraceous; mesonotum ochraceous orange, irregularly and heavily clouded with fuscous; tegmina ochraceous with a broad transverse fascia on the basal area and the apical third more or less heavily clouded with fuscous; with irregular spots on the veins in the middle of the tegmina; legs chiefly ochraceous, irregularly marked with fuscous; venter of the abdomen chiefly fuscous.

Male genitalia with the ventral border of the pygofer fairly deeply incised, lateral margins shortly triangularly produced; median area strongly, somewhat triangularly produced; genital styles elongate, nearly as long as the median ventral line of the pygofer; inner and apical angles somewhat produced; apex strongly somewhat triangularly produced; aedeagus elongate with three spines on the basal half.

Holotype: Male, Kusaie Island, 4 Dec. 1937. Allotype: Female, Oleai Atol, 21 Jan. 1938. Paratypes: 3 females, Marshall Islands, Jaluit Atol, 27 Nov. 1937; 2 females, Ponape Island, 8 Jan. 1938; 1 female, Truk Island, 16 Sept. 1937.

Myndorus palescens sp. n. (Pl. 1, Figs. 16–17)

This is a pale species with distinct male genitalia.

General color of head, thorax, venter, and legs ochraceous orange; tegmina translucent; apical and sutural margins faintly dusky, apical veins just before the apical margin blackish fuscous.

Vertex distinctly narrowed anteriorly, width at the base behind the compound eyes about twice as broad as at the apex; face nearly twice as broad across the antennae as on the dorsal margin; lateral and median carinae of the frons strongly elevated, median area of the frons below the middle of the eyes rather strongly protuberant; lateral and median carinae of the postclypeus strongly elevated.

Male genitalia with the median process of the pygofer short and broad, broadly rounded posteriorly; genital styles when viewed ventrally slightly broadened on the lateral margins, when viewed laterally strongly widened on the apical half, with two lobes; aedeagus very complex, when viewed laterally with the basal area strongly produced into a flat lobe ventrally with two short spines produced caudad; main body of aedeagus elongate, nearly uniform in width, strongly elbowed on the apical third; just before apex of the elbow with four elongate

acute spines directed cephalad; near the middle of the apical portion of the elbow with a strong acute spine directed cephalad; anal segment rather short; anal spines somewhat asymmetrical; anal style elongate, acute.

Holotype: Male, Koror Island, Palau Islands; 20 Feb. 1936.

Myndorus fusciterminalis sp. n. (Pl. 1, Figs. 7–9)

Superficially this species resembles *apicalis* but differs in color and in the male and female genitalia.

General color of the head, pronotum, and mesonotum tawny; compound eyes black; general color of the venter, including the legs, light ochraceous buff; basal segments of the abdomen light ochraceous buff, terminal segments blackish; dorsum of abdomen similarly colored; tegmina and wings semitransparent, tinged with ochraceous, veins concolorous; apical angle of tegmina and wings clouded with blackish fuscous.

Vertex nearly as long as broad; frons slightly broader than long; postclypeus longer than broad; median carina rather indistinct on the postclypeus and the ventral area of the frons; distinct dorsad.

Male genitalia with the ventral median plate of the pygofer distinctly produced, triangular; pygofer asymmetrical, the left side produced into a rounded lobe, the right side not so produced; genital styles short, rather broad, the apical half elbowed dorsad and produced into a rather acute angle apically; tenth segment asymmetrical, produced into a long ventral process which is rather acute at the apex on the left side; aedeagus complex with an elongate spine at the apex, directed cephalad and ventrad. Female with the last ventral segment with a deep incision on the posterior margin which is V-shaped; this V-shaped notch reaching about half the length of the last abdominal segment, broadly rounded at the apex.

Holotype: Male, Ponape Island, 8 Jan. 1938. Allotype: Female, Ponape Island, 4 Jan. 1938. Paratype: Male, Ponape Island, 8 Jan. 1938.

Myndorus marginatus sp. n. (Pl. 1, Figs. 10–12)

This species is distinctly colored and the male genitalia are very distinct from the other species described in this paper.

General color of the head, thorax, venter, including the legs, mars orange, somewhat clouded with fuscous; compound eyes brownish, frons clouded with pale fuscous; tegmina yellowish green, translucent, with the costal, apical, and commissural margins narrowly blackish fuscous; veins almost concolorous, with the apical veins blackish fuscous and the apical cells clouded with blackish fuscous.

Vertex about as broad as long, somewhat narrowed apically; frons about as broad as long, distinctly narrowed dorsally between the compound eyes and across the clypeal suture; lateral and median carinae fairly distinct; median ocellus distinct; postclypeus about half as long as the frons with a distinct median carina. Venation of the tegmina fairly characteristic with a distinct cross vein in the apical radial cell beyond the nodal cell and a distinct cross vein in the radiomedial cell at about the branching of media.

Male genitalia distinct; genital styles elongate, narrow, with the basal three-fourths elongate, nearly parallel-sided, the apical fourth bent at right angles to the base, gradually expanded to the apical angles with the apical margin indentate and the apical angles produced; aedeagus elongate, composed of an elongate, gradually attenuate, ventral recurved spine and a dorsal recurved spine with the apical portion recurved, broadened, and then narrowed to a rather acute apex;

anal segment short; anal spines when viewed ventrally elongate, gradually attenuated and incurved to the apex.

Holotype: Male, Ponape Island, 8 Jan. 1938.

Myndorus niger sp. n. (Pl. 1, Figs. 13–14)

In the darker-colored specimens this species is almost completely blackish fuscous; in the lighter, perhaps teneral, specimens the general color is fuscous, and the tegmina have irregular, paler, translucent areas.

Male genitalia with the genital styles elongate, inner margins distant at the base gradually curving toward the median line and then gradually diverging to the obtuse apices; when viewed laterally, narrow, of nearly uniform width, apical third bent at a right angle and directed dorsally; aedeagus with three spines, the ventral one elongate, gradually attenuate, recurved for almost half its length with a short acute process at the bend, two elongate dorsal spines, one gradually attenuate, the other capitate with a distinct spine near the apex.

Holotype: Male, Ponape Island, 8 Jan. 1938. Allotype: Female, Ponape Island, 8 Jan. 1938. Paratypes: 1 male, 2 females, Ponape Island, 8 Jan. 1938; 1 female, Ponape Island, 4 Jan. 1938.

Myndorus uniformis sp. n. (Pl. 1, Figs. 21–22)

This is another pale species with distinct male genitalia.

Head, thorax, venter, and legs light ochraceous buff; compound eyes brown with two rather large black spots on the anterior area; lateral carinae of the vertex narrowly blackish. Anterior lateral margins of the mesonotum blackish fuscous showing through the translucent prothorax. Apex of the clavus on the commissural margin narrowly blackish fuscous.

Posterior margin of the vertex slightly longer than the anterior margin, the lateral margins fairly straight, converging anteriorly.

Genital styles of the male when viewed ventrally gradually widening from the narrow base to about the apical third and then narrowed to obtuse rounded apices; when viewed laterally, distinctly elbowed just a little beyond the middle; apical portion nearly quadrangular with the anterior apical angle produced into a lobe-like process; aedeagus elongate, ventral process somewhat undulate with three distinct spines just beyond the middle; the dorsal part consisting of an elongated shaft, rather narrow, and an apical elbowed portion which is rather broad; anal segment somewhat elongate, anal spines somewhat asymmetrical; anal style very short.

Holotype: Male, Ponape Island, 2 Jan. 1938.

DELPHACIDAE Family ASIRACINAE Subfamily

Ugyops Guérin-Méneville

I have previously expressed doubt (Metcalf, 1938; 1946) as to whether all of the forty-seven species which are now assigned to this genus are really congeneric, but the type of the genus is unknown to me and until it can be studied and the genitalia carefully described and illustrated, it is useless to try to separate the species into separate genera. The species at present assigned to this genus seem to have the following characters in common; vertex elongate, narrow; frons elongate, narrow, with a simple, or a furcate, median carina or two median

carinae sometimes joined into a single median carina at the base and the apex; mesonotum with five carinae; genitalia quite variable.

Ugyops kinbergi Stål

There is a long series of this species in the present collection. While it varies greatly in color markings, there are no appreciable differences in structural characters or in the details of the male genitalia. In color the species varies from forms which have a very distinct blackish fuscous vitta extending from the pronotum behind the compound eyes, across the sides of the mesonotum, to the apex of the tegmina where it is usually decidedly wider; to forms which have numerous, irregular, small fuscous spots, principally on the veins and cross veins; to forms which have few or no such fuscous markings.

This species has been collected from the following islands: Caroline Islands, Kusaie Island, Ponape Island, Oleai Atol, Anguar Island, Marianas Islands, Rota Island, Palau Islands, Babelthuap Island.

DELPHACIDAE Family DELPHACINAE Subfamily DELPHACINI Tribe

Stenocranus Fieber

This is a genus of world-wide distribution. However, only one species has been recorded from the Pacific region and that from the Fiji Islands, and one from Australia. The greater number of species have been recorded from the Palearctic and Nearctic Regions.

Vertex narrow, longer than the basal width, distinctly protuberant in front of the compound eyes; frons narrow, median carina forked before the apex; antennae elongate, second segment distinctly longer than first. Pronotum with median and intermediate carinae, the intermediate carinae nearly straight, reaching the hind margin. Mesonotum tricarinate. Venation fairly distinct; subcosta and radius united for at least one-half the length from the basal cell; medius arising from the basal cell; radius unbranched; media one plus two merging with radius for a considerable distance; media three plus four unbranched, sometimes merging and sometimes distinct from cubitus one-*A*. Hind tibiae elongate with a spine near the base and another near the middle; apex with a row of distinct spines; calcars foliaceous with a number of teeth on the margin; basal segment of the tarsi as long as or longer than second and third segments combined; tarsal claws small.

Male genital segment usually large, subglobular; genital styles elongate, sinuate, attenuate; apex very acute; aedeagus usually simple, tubular, sometimes with spines; anal segment usually short, tubular, without anal spines.

Stenocranus carolinensis sp. n. (Pl. 1, Figs. 15, 18–19)

This is a fuscous or blackish fuscous species in general color with the antennae and the legs chiefly pale ochraceous buff and some markings along the costal and sutural margins of the tegmina pale ochraceous buff.

The genitalia, however, are very distinct, and I place this species in this genus with considerable hesitation. But until someone can revise the genera of this family not only on the basis of the characters of the head, thorax and tegmina

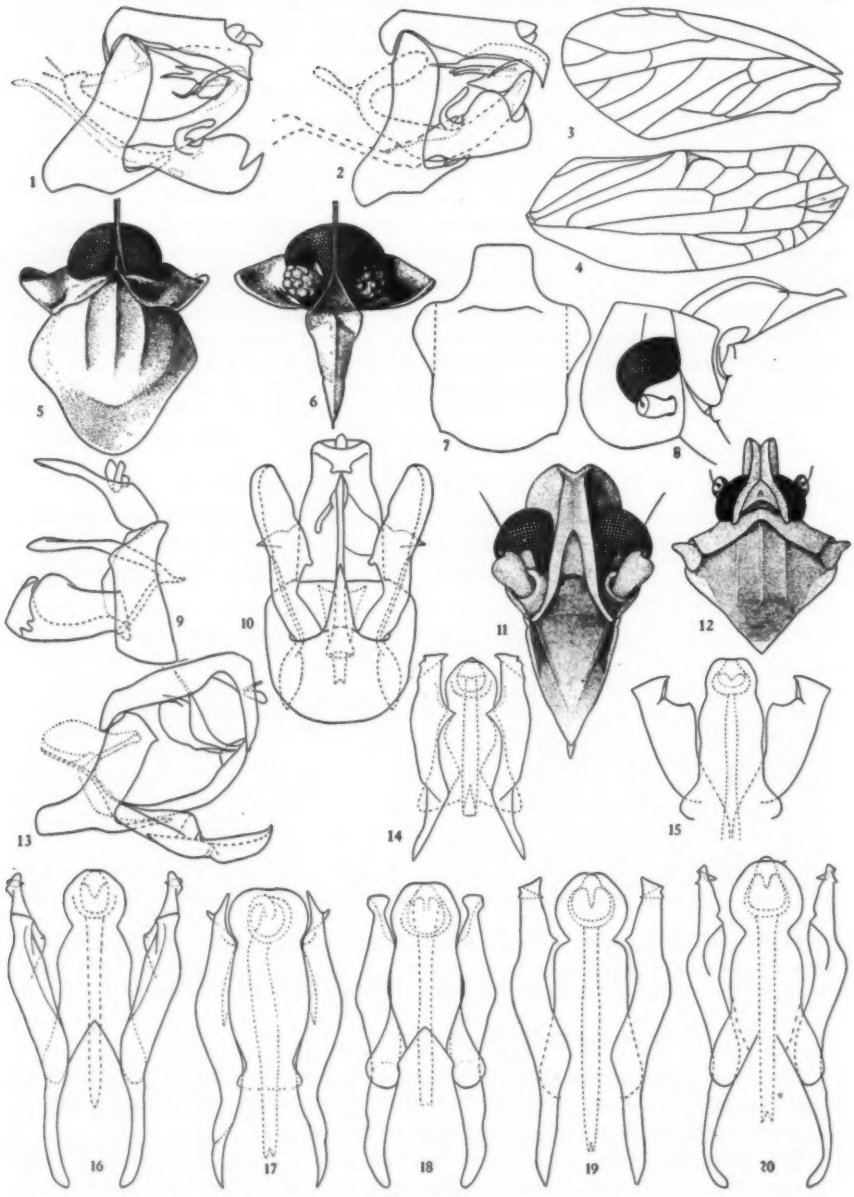

PLATE 2

but also on the basis of the characters of the genitalia, it is perhaps better to place it in this genus than erect a new genus for it.

Vertex elongate, about one and one-half times as long as the basal width, protruding in front of the eyes for about one-third of its length, rather acute anteriorly; frons elongate, narrow, more than four times as long as the median width; median carina branching about the middle of the compound eyes; antennae with the second segment about three times as long as the first. Pronotum about two and one-half times as broad as its median length, tricarinate; intermediate carinae not quite straight, broadly arched anteriorly, and united with each other and the median carina.

Male genitalia with the pygofer rather large, somewhat tubular; genital styles short with a distinct subapical tooth; apex rather obtuse; diaphragm deeply incised; aedeagus short, tubular, without processes; anal segment short, somewhat tubular, produced into elongate anal spines which reach to the base of the aedeagus; when viewed laterally, acute; when viewed posteriorly, obtuse at the apex; anal style somewhat ligulate, distinctly flattened when viewed laterally.

Length, macropterous form, 3.9 mm. to apex of tegmina.

Holotype: Male, Kusaie Island, 21 Dec. 1937. Allotype: Female, Kusaie Island, 21 Dec. 1937. Paratype: Female, Kusaie Island, 22 Dec. 1937.

DERBIDAE Family DERBINAE Subfamily CENCHREINI Tribe

Phaciocephalus Kirkaldy

This genus has a wide range in the Pacific Ocean. Species have been recorded from the Philippines, Borneo, Mysol, Larat, New Guinea, New Caledonia, Fiji, and Samoa. I know of no records from the Caroline Islands. The two species in the present collection belong to that rather large group of species in this genus which have milky or ochraceous translucent tegmina with a broad vitta,

PLATE 2

FIG. 1. *Phaciocephalus carolinensis* n. sp. Lateral view of ♂ genitalia.

FIG. 2. *Phaciocephalus onoi* n. sp. Lateral view of ♂ genitalia.

FIGS. 3, 5–7. *Malpa appressa* n. sp. FIG. 3. Venation of tegmen. FIG. 5. Dorsal view of head and thorax. FIG. 6. Facial view of head and thorax. FIG. 7. Last ventral segment of ♀.

FIGS. 4, 8, 10–13. *Ona perplexa* n. sp. FIG. 4. Venation of tegmen. FIG. 8. Lateral view of head and thorax. FIG. 10. Ventral view of ♂ genitalia. FIG. 11. Facial view of head. FIG. 12. Dorsal view of head and thorax. FIG. 13. Lateral view of ♂ genitalia.

FIG. 9. *Swezeyaria unicolor* n. sp. Lateral view of ♂ genitalia.

FIG. 14. *Lallemandana phalerata arcuata* n. var. Ventral view of genital styles and aedeagus.

FIG. 15. *Lallemandana phalerata ochracea* n. var. Ventral view of genital styles and aedeagus.

FIG. 16. *Lallemandana phalerata flavifrons* n. var. Ventral view of genital styles and aedeagus.

FIG. 17. *Lallemandana spinifera* n. sp. Ventral view of genital styles and aedeagus.

FIG. 18. *Lallemandana phalerata flavodorsalis* n. var. Ventral view of genital styles and aedeagus.

FIG. 19. *Lallemandana phalerata costalis* n. var. Ventral view of genital styles and aedeagus.

FIG. 20. *Lallemandana phalerata obscura* n. var. Ventral view of genital styles and aedeagus.

more or less complete, extending from the base on the clavus to near the apex of the clavus and then curving rather sharply to the anterior apical angle. They have distinct male and female genitalia, and I believe they are valid species.

Head rather narrow; vertex with the lateral margin distinctly pustulate; median area depressed; face elongate; frons and clypeus subequal in length; lateral margins of the frons elevated, distinctly pustulate; clypeus smooth without pustules; median carina more or less distinct. Pronotum short and broad; not distinctly carinate dorsally; lateral carinae strongly produced into a broad, laminate, subantennal process; mesonotum slightly broader than long; carinae indistinct. Tegmina with venation fairly constant; costal cell elongate; nodal cell nearly quadrate; subcostal cell elongate; radius usually with two branches only; media with five or more branches.

Phaciocephalus onoi sp. n. (Pl. 2, Fig. 2)

This species belongs to the group which contains *funebris* and *badius*, but it may be separated from these species by its distinctive coloration; the male and female genitalia also seem to be quite characteristic.

Vertex not quite as long on the median line as its extreme width at base; frons a little longer than the postclypeus. Pronotum a little more than half as long as the vertex. Mesonotum broader than long.

General color dorsally and ventrally light ochraceous buff; compound eyes blackish fuscous; disc of the vertex sometimes clouded with fuscous, lateral carinae usually narrowly blackish. Pronotum more or less clouded with blackish fuscous. Mesonotum chiefly blackish fuscous; clavus ochraceous orange; a rather broad vitta extending from the apical margin of the claval suture to the anterior apical angle; tegmina more or less translucent whitish; legs with the spines blackish; dorsal area of the abdomen clouded with fuscous.

Male genitalia with the ventral plate of the pygofer strongly produced; genital styles, when viewed laterally, with a strongly curved process at about the base of the apical half; this process with a distinct triangular basal tooth; beyond the process the genital styles broadly rounded produced dorsad with a triangular tooth at the anterior base of this process; apex of the genital styles produced in a strong acute dorsal tooth; aedeagus with the ventral arm rather narrow; dorsal arm short and broad with three pairs of subapical spines; anal segment elongate, strongly produced ventrad at the apex of the triangular tooth. Female genitalia with the last ventral segment about as long as broad basally; median area produced into a tooth that is subquadrate with the apex nearly truncate; lateral margins scarcely produced.

Holotype: Male, Truk Island, 9 Jan. 1936. Allotype: Female, Truk Island, 9 Jan. 1936. Paratypes: 8 males, Truk Island, 9 Jan. 1936; 7 females, Truk Island, 9 Jan. 1936.

Phaciocephalus carolinensis sp. n. (Pl. 2, Fig. 1)

This is a rather variable species as far as color is concerned. The more typical specimens seem to be light ochraceous buff with the eyes blackish and the vitta of the tegmina confined to the apical area and rather irregular in depth of color and in width; the male genitalia are of the typical spiniferous type.

Vertex rather short and broad, nearly twice as broad at the base as the median length; anterior and posterior incisions rather deep; frons longer than the post-

clypeus, rather narrow between the compound eyes and then gradually widened about as wide as the postclypeus. Pronotum nearly as long as the vertex, anterior margin rather obtuse. Mesonotum rather short and broad, its median length nearly three times the length of the pronotum. Venation regular.

Male genitalia when viewed laterally with the genital plate about as long as the dorsal width of the pygofer; genital styles relatively broad and short, the dorsal process rather elongate with a distinct triangular basal tooth; dorsal arm of the aedeagus produced into an elongate gradually acuminate apical process and two pairs of subapical spines; dorsal pair elongate, narrow, recurved; ventral pair trifid; anal segment elongate, anal spines acute; female genital segment relatively small, posterior lobe broad, apical margin broadly rounded.

General color dorsally and ventrally ochraceous buff, eyes black, vitta of the tegmina fuscous extending from the apical half of the claval suture to the anterior apical angle; dorsal segments of the abdomen blackish fuscous.

Holotype: Male, Truk Island, 9 Jan. 1936. Allotype: Female, Truk Island, 9 Jan. 1936. Paratypes: 10 males, Truk Island, 29 Dec. 1935 and 9 Jan. 1936; 9 females, Truk Island, 29 Dec. 1935 and 9 Jan. 1936.

OTIOCERINI Tribe

Malpa gen. n.

Orthotype *Malpa appressa* sp. n.

This genus may be readily recognized by the peculiar structures of the head; the vertex and the frons are composed chiefly of the closely appressed lateral carinae; the subantennal process is short but extends a considerable distance from the cheeks; the antennal foveae are strongly developed.

Head narrower than the pronotum; vertex broadly rounded to the frons; clypeus elongate, rather broad basally, gradually narrowed to a rather acute apex. Pronotum rather short on the median line, projecting distinctly between the compound eyes; posterior margin broadly incised, lateral margin strongly developed into antennal foveae. Mesonotum elongate, median and intermediate carinae rather indistinct. Tegmina rather short and broad; wings about as long as the tegmina, venation of the tegmina distinct; radius with two branches, medius with four, and cubitus with one.

Malpa appressa sp. n. (Pl. 2, Figs. 3, 5–7)

This is a rather inconspicuous species with the general color of the body and legs ochraceous buff.

Compound eyes blackish fuscous; tegmina semitransparent with a bright red nodal cell and a rather broad fascia extending across the cross veins of the tegmina to the posterior apical angle; a rather indefinite fuscous clouding about halfway between this fascia and the base of the wings.

Vertex elongate, about one and one-half times as long as the diameter of the compound eyes, lateral carinae closely appressed to near the middle of the compound eyes, then gradually diverging to the posterior border which is deeply incised to about the middle of the compound eyes; frons with the lateral carinae strongly appressed to near the lower border of the compound eyes and then diverging to the broader clypeus below the level of the subantennal process; clypeus about as long as the frons; lateral margins of the clypeus gradually tapering to the rather acute apex; compound eyes rather large with a deep ventral sinus;

antennae with the first segment very short and the second segment subglobulate. Pronotum rather short on the median line, gradually widening laterally, anterior margin strongly projected between the compound eyes and the posterior margin deeply incised. Mesonotum about as long as broad, median and intermediate carinae indistinct. Tegmina short and broad, *Sc* and *R* united to about the middle; *R* with two branches; *M* united to *Sc-R* stem for a considerable distance with four branches; *Cu* with two branches; clavus open.

Female genitalia with the last ventral segment slightly longer than broad; slightly widened on the median third and then constricted and produced into a nearly quadrate process on the apex.

Length to apex of tegmina 3.2 mm.

Holotype: Female, Truk Island, 21 Dec. 1935.

Ona gen. n.

Orthotype *Ona perplexa* sp. n.

Head narrow, vertex elongate, projecting for nearly half its length in front of the compound eyes; lateral margins broad closely appressed to near the anterior margin of the eyes and then strongly divergent to the posterior margin; lateral margins slightly pustulate posteriorly; vertex meeting the frons at almost a right angle; lower margin of the frons when viewed laterally strongly rounded and directed posteriorly; lateral margins of the frons closely appressed to near the middle of the compound eyes and then diverging and broadly rounded posteriorly; clypeus broadly triangular; compound eyes rather large, ventral sinus fairly deep, no subantennal process. Pronotum short and broad, posterior margin deeply incised, nearly parallel to the anterior margin. Mesonotum nearly as long as broad; median and intermediate carinae fairly distinct. Tegmina with the costal cell broad, the subcostal cell short and narrow, the radial cell elongate; media with three branches before the subapical vein; cubitus ending in the subapical vein but the clavus nearly closed.

Ona perplexa sp. n. (Pl. 2, Figs. 4, 8, 10–13)

This is an inconspicuous dull greyish species with the dorsum of the abdomen and the venter chiefly blackish fuscous.

Pronotum marked with two pairs of rather broad brownish vittae; compound eyes and antennae brownish; anterior legs blackish fuscous, intermediate and hind legs greyish, with the tibiae indistinctly ringed with brownish and the tarsi more or less brownish or blackish fuscous; tegmina and the wings are semiopaque, greyish, with the veins distinctly browner.

Vertex about one and one-half times as long as the greatest width; lateral margins closely appressed in front of the compound eyes; posterior margin broadly incised; discal area nearly twice as broad as long; frons nearly as long as the clypeus; clypeus broadly triangular. Pronotum short and broad, nearly eight times as broad as the average length; anterior and posterior margins subparallel. Mesonotum not quite as long as the greatest width.

Pygofer small and short; posterior process rather long, when viewed ventrally acutely triangular; genital styles when viewed ventrally rather irregular in outline with a distinct lobe on the apex of the basal half; aedeagus elongate, narrow; apex with two broad processes which have acute apices; anal segment elongate, the apical third bent ventrad at nearly a right angle.

Length to the apex of the tegmina 5.1 mm.

Holotype: Male, Ponape Island, 1 Jan. 1938. Allotype: Female, Ponape Island, 31 Dec. 1937.

TROPIDUCHIDAE Family TAMBINIINAE Subfamily TAMBINIINI Tribe

Swezeyaria Metcalf

This genus was recently described (Metcalf 1946) for a single species, *Swezeyaria viridana* Metcalf, from Guam. The present collection contains an additional species from the Caroline Islands.

Swezeyaria unicolor sp. n. (Pl. 2, Fig. 9)

This species is quite similar to *viridana* in color but differs in general characters as follows: Dorsal field of the pronotum decidedly longer than in *viridana*, projecting to the level of the anterior margin of the eyes; wing venation varying slightly, the most consistent difference being that there are only two cross veins between the branches of radius and media whereas in *viridana* there are four such cross veins. Male genitalia in *unicolor* asymmetrical; the processes of the genital plates differing decidedly from *viridana* in that the anterior process is short and obtuse; aedeagus quite similar except that in *unicolor* it increases gradually to the apical area and then is subacute to the apex.

This species averages larger than *viridana*. The largest of the females is 6.3 mm. to the apex of the abdomen and 8.4 mm. to the apex of the tegmina. The smallest male is 4.5 mm. to the apex of the abdomen and 6.9 mm. to the apex of the tegmina.

Holotype: Male, Ponape Island, 16 Jan. 1938. Allotype: Female, Ponape Island, 16 Jan. 1938. Paratypes: 3 males, 1 female, Ponape Island, Jan. 1938; 5 males, 3 females, Kusaie Island, Dec. 1937.

RICANIIDAE Family

Armacia Stål

Armacia clara Stål

There is a long series of this species in the present collections from the Caroline Islands, Ponape Island, the Truk Islands, Palau Islands, Angaur Island, Babelthuap Island, and Korror Island.

Armacia clara pallescens Metcalf

There is a good series of this variety in the present collection with the characteristic coloration but with no important differences in structural characters and the characters of the male genitalia. They are all from the Caroline Islands, Kusaie Island, and Ponape Island.

APHROPHORIDAE Family

Lallemandana China and Myers

Since many of the earlier species of this genus were described chiefly on color characters, with very few outstanding structural characters, it is rather difficult to correlate these species. Unless species in the present collection agree in detail with previously described species, subspecies, or varieties, they have been described as new in the hope that future workers who have access to the types of these earlier species will make comparisons and studies and straighten out the details of the true relationship of the various forms. No description of the

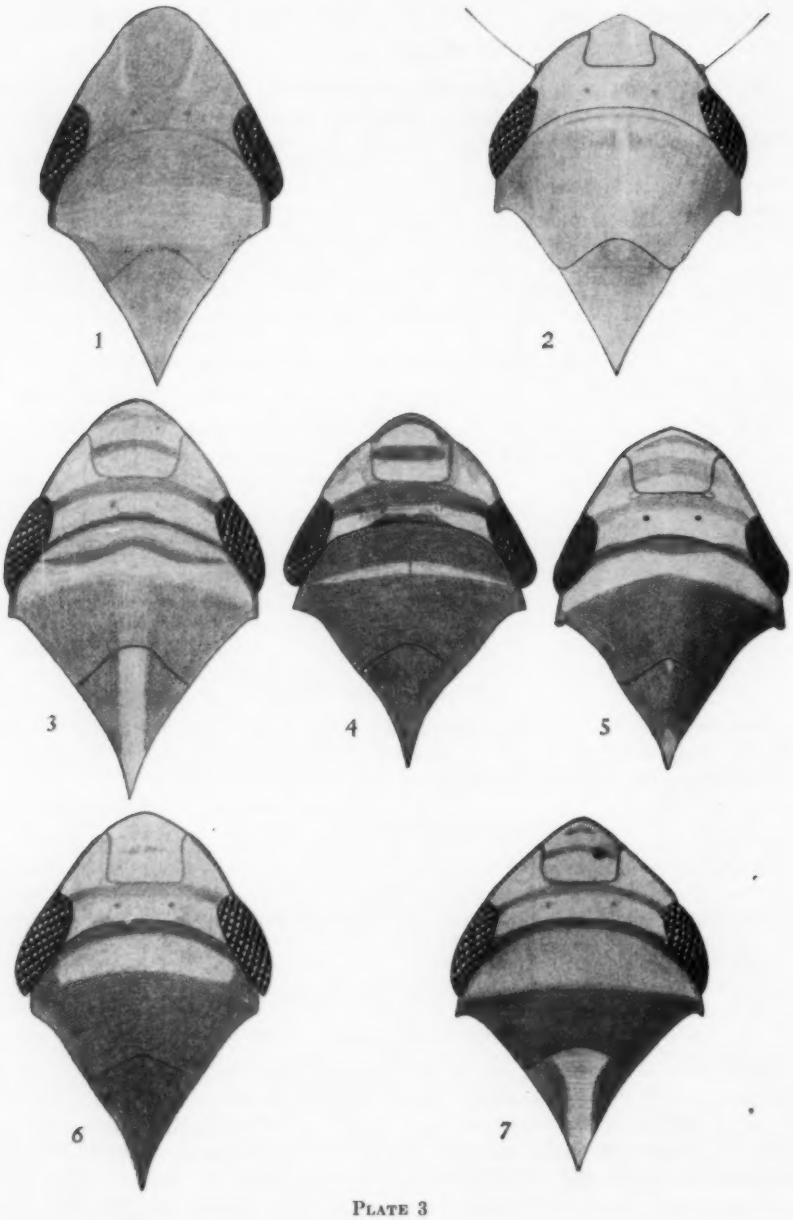

PLATE 3

genus is appended at this time because detailed descriptions have been published recently (China, 1933; China and Myers, 1934).

Lallemandana phalerata Stål

If all of the records are to be accepted this is also a widely distributed species. Previous writers have recorded it from Java and the Philippines to Guam, the Marianas, and the Caroline Islands. It was described originally without definite locality (Stål, 1854). Later, Stål (1859) recorded it from Guam, the Marianas, Ponape Island, and the Caroline Islands. Dohrn (1859) lists it from Java, perhaps because Stål described it originally, placing it between two species from Java, and Dohrn simply lists it with these two species. Melichar (1914) and Lallemand (1912) catalogue it from Java. China (1933) records it from Guam, the Marianas, the Caroline Islands, and Ponape Island. If I have determined the present material correctly this is also a very variable species; in this respect it is similar to *fenestrata* which has been studied in some detail by China. I describe below six varieties of this species based chiefly upon color characters and minor variations in the details of structural characters. The decision as to whether these are valid or not will have to await a restudy of the original type series and much more material than is at present available to me.

Lallemandana phalerata var. **obscura** var. n. (Pl. 2, Fig. 20; Pl. 3, Fig. 4)

This variety is largely fuscous above and below.

Crown crossed by three rather narrow ochraceous buff fascia, one close to the anterior margin, another just in front of the compound eyes, and the third on the posterior border. Compound eyes ringed with ochraceous buff and pronotum with a narrow fascia on the anterior third. Tegmina fuscous on the base with the apical margin rather broadly ochraceous, translucent. Beneath, the head, thorax, and abdomen chiefly fuscous; with a broad yellowish ochraceous vitta extending from the lateral areas of the postclypeus across the cheeks and pronotum to the mesonotum; femora of all the legs chiefly ochraceous buff, tibiae and tarsi largely fuscous.

Male genitalia with the genital styles rather narrow when viewed ventrally; when viewed laterally gradually widening to about the apical third and then rather deeply and semicircularly incised both dorsally and ventrally with the dorsal and ventral angles about equally produced; dorsal arm of the aedeagus elongate with the apex upcurved, fairly obtuse.

PLATE 3

Dorsal view of the head and thorax of a new species and some new varieties of the genus *Lallemandana*

FIG. 1. *Lallemandana phalerata flavodorsalis* n. var.
FIG. 2. *Lallemandana spinifera* n. sp.
FIG. 3. *Lallemandana phalerata ochracea* n. var.
FIG. 4. *Lallemandana phalerata obscura* n. var.
FIG. 5. *Lallemandana phalerata flavifrons* n. var.
FIG. 6. *Lallemandana phalerata costalis* n. var.
FIG. 7. *Lallemandana phalerata arcuata* n. var.

Specimens are at hand from the Caroline Islands, Truk Island, Kusaie Island, the Mariana Islands, and Rota Island.

Lallemandana phalerata var. **ochracea** var. n. (Pl. 2, Fig. 15; Pl. 3, Fig. 3)

In this variety the general color is ochraceous tawny, rather conspicuously marked with ochraceous buff and black or fuscous.

Crown chiefly ochraceous buff with the anterior narrowly margined with blackish or blackish fuscous; this widens out across the antennae and the compound eyes and becomes a rather broad vitta on the lateral margins of the thorax; coronoclypeus with a small spot of ochraceous tawny near the anterior margin and a fairly broad and distinct fascia just behind the middle; with another broad fascia between the coronoclypeus and the ocelli, extending between the compound eyes. Pronotum chiefly ochraceous tawny, anterior margin narrowly bordered with blackish and about the anterior third ochraceous buff with a rather distinct, transverse, ochraceous tawny fascia which is nearly complete. Mesonotum largely ochraceous tawny with an ochraceous yellow median vitta. Face chiefly ochraceous yellow with a distinct blackish vitta extending across the apical margin of the postclypeus and the lateral borders of the thorax to merge with the dorsal vitta which extends across the compound eyes and the lateral margins of the thorax; anteclypeus ochraceous yellow sometimes with a very distinct central area clouded with ochraceous tawny. Beneath, including the legs, chiefly ochraceous tawny with tibiae and tarsi blackish fuscous. Tegmina with three or four rather distinct ochraceous yellow spots, one at the base of the clavus, extending along the claval suture for a short distance, another extending from radius to media, near the center of the tegmina; nodal area semitranslucent, somewhat ochraceous in color.

Genital styles broad and short; lateral margins nearly straight; apical sinus nearly semicircular in outline, rather deep; outer angle nearly a right angle and the inner angle somewhat obtusely produced; aedeagus short and broad but little longer than the genital styles.

Specimens are at hand from Saipan, Mariana Islands.

Lallemandana phalerata var. **flavodorsalis** var. n. (Pl. 2, Fig. 18; Pl. 3, Fig. 1)

In this variety the crown, pronotum, and mesonotum almost unicolorous ochraceous orange.

Narrow anterior margin of the crown and dorsal margin of the face blackish fuscous, extending as a broad blackish vitta across the lower margin of the eyes and the lateral margins of the thorax. Beneath, including most of the legs, ochraceous orange; legs irregularly marked with blackish or blackish fuscous. Basal area of the corium of the tegmina chiefly blackish to the apical cells; clavus chiefly semitranslucent, ochraceous buff in color; apical cells translucent; usually a broad ochraceous yellow vitta extending from the base of the clavus to the median area of the tegmina; this vitta sometimes interrupted and forming a distinct yellowish spot between radius and medius; with an oblique fascia extending from the costal margin across the subapical cells.

Male genitalia with the genital styles elongate, narrowed, when viewed ventrally, with the apex somewhat capitate, the outer and inner angles broadly rounded; when viewed laterally, genital styles somewhat broader with the apical sinus rather deep, semicircular; aedeagus short and broad.

Specimens are at hand from the Palau Islands, Anguar and Peliliou.

Lallemandana phalerata var. **arcuata** var. n. (Pl. 2, Fig. 14; Pl. 3, Fig. 7)

In this variety the coloring is chiefly blackish fuscous, fuscous, and ochraceous tawny, heavily marked with pale ochraceous buff or whitish.

Crown chiefly ochraceous buff with the narrow anterior margin blackish fuscous and an incomplete transverse fascia near the middle of the coronoclypeus, and another fascia in front of the ocelli behind the coronoclypeus fuscous or blackish fuscous. Pronotum chiefly ochraceous tawny, anterior margin broadly blackish or blackish fuscous, bordered by a broad pale ochraceous fascia. Mesonotum chiefly blackish fuscous with a pale median vitta extending from anterior margin to the apex. Tegmina chiefly blackish fuscous, with a whitish arcuate vitta extending from the base across the basal half of the clavus and then curving sharply to the costal margin; posterior apical cells and the commisural margin chiefly pale translucent; a large nodal area whitish translucent. Beneath chiefly blackish fuscous and ochraceous tawny; frontal portion of the clypeus chiefly ochraceous yellow on the basal two-thirds with the dorsal margin narrowly black; ventral margin broadly blackish fuscous; the pale dorsal area extending as a short vitta beneath the compound eyes across the cheeks to the pronotum; legs chiefly ochraceous tawny, more or less marked with blackish or blackish fuscous.

Male genital styles rather narrow; inner margins with two broad shallow incisions, produced into a strong, rather acute tooth at about the middle; outer margin slightly widened from the base to the middle and then narrowing somewhat to the apex; outer apical angle produced into two small teeth, inner apical angle produced into an elongate, somewhat acute tooth; dorsal arm of the aedeagus longer than the basal arm, obtuse at the apex.

Specimens are at hand from Rota Island and Tinian Island in the Marianas.

Lallemandana phalerata var. **costalis** n. var. (Pl. 2, Fig. 19; Pl. 3, Fig. 6)

This variety is chiefly fuscous or blackish fuscous in color, heavily marked with ochraceous yellow.

Crown chiefly ochraceous yellow with the anterior margin narrowly blackish; with a very indistinct cloud of fuscous on the coronoclypeus and a rather narrow fuscous fascia extending across the crown between the compound eyes, posterior to the coronoclypeus and in front of the ocelli. Pronotum chiefly blackish with a rather broad fascia extending behind the compound eyes, but not reaching the lateral margins. Mesonotum unicolorous, blackish fuscous.

Male genitalia with the subgenital plates shorter than the genital styles; when viewed laterally, genital styles rather short and broad with a distinct dorsal sinus broadly rounded and rather deep and a very shallow ventral sinus; genital styles shorter than the anal segment; dorsal arm of the aedeagus elongate, rather obtuse at the apex; when viewed ventrally the genital styles are narrow, elongate, with a distinct median tooth at the base of the apical third.

Lallemandana phalerata var. **flavifrons** var. n. (Pl. 2, Fig. 16; Pl. 3, Fig. 5)

This variety is considerably larger than the average of the other varieties, measuring about 8.5 mm. to the apex of the tegmina. The color characters are decidedly different from the varieties described above, but I can find no good structural characters to separate this from *phalerata*.

Crown ochraceous buff, lateral margins in front of the compound eyes narrowly blackish; three distinct ochraceous tawny fascia, one immediately behind the anterior margin, another across the middle of the coronoclypeus and a third extending across the crown between the compound eyes posterior to the coronoclypeus and in front of the ocelli. Anterior margin of the pronotum blackish fuscous, with a broad, transverse, ochraceous buff fascia behind; posterior half of the pronotum blackish fuscous. Mesonotum brown without a median vitta; only a small spot on the anterior margin, and the posterior apex ochraceous buff. Tegmina brownish, costal margin anteriorly blackish fuscous; shoulders with a small elongate spot of ochraceous buff; a somewhat interrupted ochraceous fascia extending from the radius across the corium and to the first claval vein; a large ochraceous buff spot extending from the costal margin across the subapical cells to the medius. Entire face except the narrow dorsal margin, which is blackish fuscous, ochraceous buff; this color extending across the cheeks and across the lateral margins of the thorax as an ochraceous vitta bordered above and below by blackish fuscous.

Genital styles of the male when viewed ventrally rather narrow, when viewed laterally widened to the apical third with a rather deep, somewhat triangular sinus, dorsal angle strongly produced.

There is a single specimen in the present collection from Rota Island, Marianas.

Lallemandana spinifera sp. n. (Pl. 1,Fig. 20; Pl. 2, Fig. 17; Pl. 3, Fig. 2)

As far as general structure is concerned this species resembles *phalerata* very closely except that the crown is much shorter than is typical in that species.

Crown short and broad, about one-half as long as the width between the compound eyes. Pronotum about one and one-fourth times as long as the crown. Mesonotum as long as the pronotum. Tegmina semicoriaceous; venation distinct, with six apical cells beyond the clavus.

When viewed laterally the male genital plates elongate, as long as the genital styles and the genital segments; apex rather obtuse; genital styles rather broad with distinct dorsal and ventral sinuses; apex obtuse; dorsal and ventral angles produced; with a strongly produced subapical spine anterior to the ventral angle; aedeagus with the dorsal arm somewhat sinuate, obtuse at the apex; when viewed ventrally the genital styles narrow, elongate.

General color of the crown, pronotum, and mesonotum ochraceous buff; compound eyes and lateral margins of the pronotum fuscous; tegmina fuscous with two irregular pairs of ochraceous spots, one near the apex of the basal half of the tegmina extending from costal margin to cubitus, the other in the nodal area extending from the costal margin to media. Venter, including the face, clypeus, labium, venter of the thorax, legs, and venter of the abdomen, light ochraceous buff; spines and claws of the legs blackish fuscous.

Length to apex of tegmina 5.7 mm.

Holotype: Male, Mariana Islands, Rota Island, 8 Sept. 1937.

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THE STATUS OF THE NAMES SCIURUS NIGER CINEREUS LINNAEUS AND SCIURUS NIGER VULPINUS GMELIN

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PLATES 4–5

During the course of a taxonomic study of the fox squirrels, it was discovered that the name *Sciurus niger neglectus* Gray (1867:425), which is currently applied to the subspecies occupying the Eastern Shore of Maryland, should be superceded by *Sciurus niger cinereus* Linnaeus (1758:64).

The scantiness of the description of *Sciurus* [*niger*] *cinereus* in Linnaeus' tenth edition (1758:64) leaves much to be desired; although, in the author's opinion, two of his three references (Ray, 1693:215; Catesby, 1754:74; Kalm, 1753:409) clearly establish the identity of this form.

Ray's description of the squirrel's being the size of the common rabbit is somewhat extravagant, but his designation "*The great grey Virginia squirrel*" indicates that he was probably aware of the difference between this squirrel and the gray squirrel (*Sciurus carolinensis*), which occurs throughout Virginia.

Catesby's (1754: vol. II, p. 74, pl. 74) description fits the animal quite well, but it is sufficiently ambiguous to include the gray-white phase of *Sciurus niger niger* when his use of the word "body" is interpreted to include only the torso. The engraving, however, clearly depicts *Sciurus niger cinereus* rather than *Sciurus niger niger*. The whitish nasal and forehead patches usually found in *cinereus* (Plate 4, fig. 2) are clearly shown; and the black hood, invariably present in *niger*, is not in evidence (Fig. 3, left).

Catesby was aware of the presence of the gray squirrel, *Sciurus carolinensis*, for in Vol. II, page xxiv, he states:

"Besides the description of those particular beasts inhabiting the countries

> here treated of, I shall give an account of the beasts in general of North America, which are [the] . . . , Gray Squirrel, Gray Fox Squirrel, Black Squirrel, Ground Squirrel, Flying Squirrel . . . ".

Unfortunately, he neglected to "give an account" of the gray squirrel in his text proper.

It seems inconceivable, moreover, that Catesby could have been unaware of the difference between *Sciurus niger cinereus* and *Sciurus niger niger*, for he spent seven years in Virginia and four in South Carolina. In both locations, much of his time was spent within the range of these two subspecies. His following statement (Vol. I:x) should dispel some of the doubt as to whether the white areas on the nose and forehead were intended to represent highlights or actual white patches:

> "As I was not bred a Painter I hope some faults in Perspective, and other Niceties, may be more readily excused, for I humbly conceive Plants, and other Things done in a Flat, tho' exact manner, may serve the Purpose of Natural History, better in some Measure than in a more bold and Painter like Way."

This author, however, has yet to see a melanistic *Sciurus niger niger* with a white ring around its neck (Plate 5).

The original edition of Kalm (1753), was not examined; however, both the German version (1759) and the English version (1770–1) as well as Adolph B. Benson's (1937) translation of the 1753 edition were consulted. It is obvious that Kalm (1753:**2**:409) used the name *Sciurus cinereus* Linnaeus for designating both *Sciurus niger* and *Sciurus carolinensis*, probably because it was the only available name in Linnaeus' Systema Naturae at the time. It was not until some forty years later that Gmelin (1788:148) described *Sciurus carolinensis*. Erxleben's (1777:418) description and a few of his citations fit *Sciurus n. cinereus*, but some of the references apply to *Sciurus carolinensis*.

The "gray" squirrel in Pennant's (1781:410) *History of Quadrupeds* is a composite for his citations and description fit *Sciurus carolinensis* almost as well as *Sciurus niger*. The accompanying illustration (p. 412) depicts a hooded squirrel, probably *Sciurus niger niger*. Schreber's (1784:766–72, and 1791: pl. ccxiii) *Sciurus cinereus* is *Sciurus carolinensis*. Gmelin's (1788:147) references for *Sciurus cinereus* include not only this variety but also *Sciurus carolinensis* and at least two additional subspecies of *Sciurus niger*. Gmelin's citations were copied by Kerr (1792:258) and the inaccuracies continued.

Desmarest (1820:332) applied the name *Sciurus cinereus* to *Sciurus carolinensis*, as did Harlan (1825:173). Godman (1826:129) did not fall into Desmarest's and Harlan's errors regarding the use of *cinereus* for *carolinensis*, but he applied the name *cinereus* to the subspecies *Sciurus niger niger* Linnaeus ,and *Sciurus niger bachmani* Lowery and Davis. Bachman (1838:89) corrected Godman's faulty designation, but treated both *Sciurus niger cinereus* and *Sciurus niger vulpinus* as a single form, *Sciurus cinereus*. Baird (1859:248) applied the name *cinereus* to the form not only from the Eastern Shore of Maryland, but also from as far away as Carlisle, Pennsylvania, and Clarke County, Virginia.

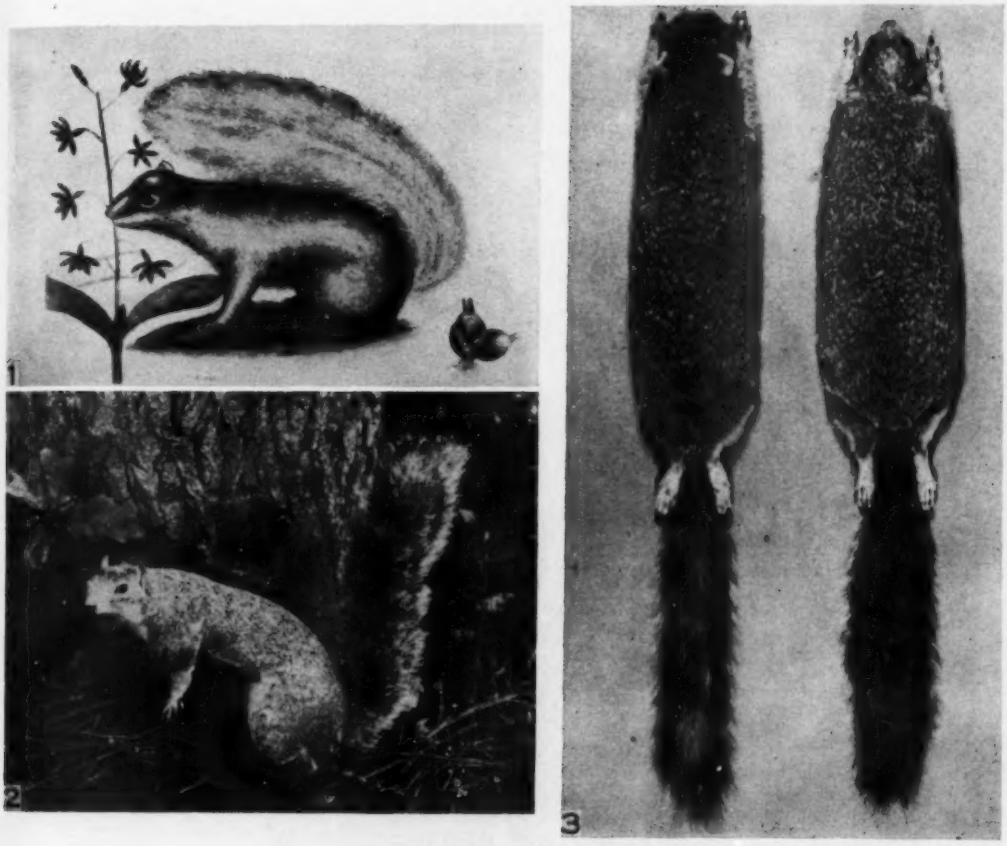

PLATE 4

FIG. 1. Catesby's Gray Fox Squirrel.

FIG. 2. *Sciurus niger cinereus* Linnaeus as *Sciurus niger bryanti* Bailey from Dozier and Hall (1944).

FIG. 3. Left: *Sciurus n. niger* Linnaeus from Georgetown County, South Carolina. Right: *Sciurus n. cinereus* Linnaeus from Dorchester County, Maryland.

Gray (1867:417) lists a squirrel collected in "Pennsylvania" as *Sciurus cinereus;* but the vague, ambiguous description makes a positive identification virtually impossible. Gray's (1867:425) *Macroxus neglectus* is a synonym of *Sciurus niger cinereus* Linnaeus, and was later recognized as such by Coues and Allen (1877:717).

Bangs (1896:152) was responsible for the fact that the name *cinereus* was "lost" for the second time, for he was not aware of this coastal variety. Unfortunately, Oldfield Thomas (1911:149) accepted Bang's conclusions and re-

PLATE 5
Catesby's Black Squirrel.

ported *cinereus* to be synonymous with *niger*. Nelson (1900:169) erred in placing Bang's *vicinus* in synonymity with *Macroxus neglectus* Gray and was corrected by Poole (1944:315). Dr. Poole also correctly placed *bryanti* (Bailey, 1920:1) in synonymity under *neglectus*, but as indicated above both *bryanti* and *neglectus* are preceded by the *cinereus* of Linnaeus. The correct name, therefore, for the fox squirrel occupying the Eastern Shore of Maryland is *Sciurus niger cinereus* Linnaeus (Table 1).

Additional light on the status of the name *Sciurus niger vulpinus* Gmelin was also revealed during the course of taxonomic study of the fox squirrels. Bangs, (1896:**10**:150) gave the name *Sciurus ludovicianus vicinus* to the fox squirrels whose range lies largely east of a line from Greenbrier County, West Virginia, to Orange County, New York. The name *Sciurus vulpinus*, however, was applied to this population as early as 1788, at which time it appeared in Gmelin's (1788:147) thirteenth edition of Linnaeus' Systema Naturae. The name *vulpinus*, therefore, supersedes that of *vicinus* by over one hundred years.

In a letter to Schreber dated November 3, 1784, Schoepf supplied some data and a brief description of the two fox squirrels which were brought to him on his return to Baltimore from Ohio and which he had previously sent to Schreber. He informed Schreber that he first heard of the forms mentioned in the Blue Mountains (Pennsylvania) and that they were known by the name of "Fox-squirrels" in both Pennsylvania and Maryland. Schreber published ex-

TABLE 1

Sciurus niger cinereus Linnaeus

1758. *Sciurus cinereus* Linnaeus, 1758:64.
1759. *Sciurus cinereus* Kalm, 1759; 1770–1:**1**:311. Kalm applied the name *Sciurus cinereus* Linnaeus to both *Sciurus niger* and *Sciurus carolinensis*.
1777. *Sciurus cinereus* Erxleben, 1777:418. In part.
1781. *Sciurus cinereus* Pennant, 1781:410. Applies to *Sciurus niger* probably subspecies *niger*; it is not a synonym of *S. n. cinereus* Linnaeus.
1784. *Sciurus cinereus* Schreber, 1784:766; 1791:pl. 213. A synonym of *Sciurus carolinensis* Gmelin.
1788. *Sciurus cinereus* Gmelin, 1788:**13**:147. In part.
1792. *Sciurus cinereus* Kerr, 1792:258. In part.
1820. *Sciurus cinereus* Desmarest, 1820:332. A synonym of *Sciurus carolinensis* Gmelin.
1825. *Sciurus cinereus* Harlan, 1825:173. A synonym of *Sciurus carolinensis* Gmelin.
1826. *Sciurus cinereus* Godman, 1826:129. A composite which includes both subspecies *S. n. niger* Linnaeus and *S. n. bachmani* Lowery and Davis.
1838. *Sciurus cinereus* Bachman, 1838:89. In part.
1859. *Sciurus cinereus* Baird, 1859:248. In part.
1867. *Sciurus cinereus* Gray, 1867:417. Possibly a synonym of *S. n. vulpinus* Gmelin; it is not a synonym of *S. n. cinereus* Linnaeus.
1867. *Macroxus neglectus* Gray, 1867:425.
1877. *Sciurus niger cinereus* Allen, 1877:717. In part.
1900. *Sciurus ludovicianus neglectus* Nelson, 1900:**13**:169. A synonym of *S. n. vulpinus* Gmelin.
1907. *Sciurus niger neglectus* Osgood, 1907:**20**:45. In part.
1920. *Sciurus niger bryanti* Bailey, 1920:**1**:1.
1944. *Sciurus niger neglectus* Poole, 1944:**25**:315

cerpts from Schoepf's letter with his own additional detailed descriptions of the two animals. The following translation of a portion of Schreber's description is sufficient to make it obvious that the specimens he described were representatives of the population to which the name *Sciurus niger vicinus* Bangs is currently applied.

> "It has almost the same size and proportions of head, tail, and other parts as the gray squirrel, and almost the same color except that the white on the body tends more toward yellow, and the tail, instead of the gray hair-tips, shows yellow. The courtesy and disposition of Herrn Hofmedicus D. Schoepf enables me to describe two such fox squirrels. On the upper lip and back, one is brownish-yellow (meloncolored), which is blended with black under the eyes. The long vibrissae and eye-bristles are entirely black. A circle of the first mentioned color surrounds the eyes. The ears are likewise covered with brownish glossy, appressed hair. They have neither beard nor ear-tufts. The hair of the head, body, and also the base of the tail, is heavy, and of varying brown, black, and whitish-yellow color; the tip is ordinarily black. The squirrel resembles the porcupine in color. Black is the dominant color on the head. The hairs on the underside of the long tail are a mixture of colors similar to that which is on the back. Further out, brownish mixes in. The greatest part of the tail is mottled brownish and black. Toward the tip of the tail, the black color bends back as an oval arc within the brown circle, parallel to the same. Throat, breast and abdomen are white, but with a little mixture of brownish yellow. The feet are brownish yellow; on the front ones the black hairs are intermingled."

The English term "Fox-squirrel" used in Schoepf's letter was translated into the German "Fuchseichorn" by Schreber and used as the title of section 3 on page 772. This fascicle, according to Sherborn, was published in 1785. Schreber applied no Latin name to the squirrels described in this section of the fascicle, although a reference is made to an illustration for the text, Plate 215B, on which appears the caption, "*Sciurus vulpinus* Lawson."

When referring to Gmelin's Latin description of *vulpinus*, it is obvious that he obtained at least a part, if not all, of his information from Schreber, although he gives credit to Schoepf as his source. The statement that the hair of *vulpinus* was more coarse (hard) than that of the common European squirrel was apparently taken from that portion of Schreber's description on page 773, while the remainder of the description is completely included in the excerpts of Schoepf's letter as published in Schreber's *Saugthiere*, pages 774 and 775. Schoepf (1788) does not use the name *Sciurus vulpinus* in his *Travels in the Confederation*, although he does mention fox squirrels. In the majority of cases when Schoepf referred to a plant or animal, he also included its scientific name. Schoepf's *Reise* was published just two months before Gmelin's work in which the name *Sciurus vulpinus* occurs. It is the opinion of this author that Gmelin was actually the first to apply the name *vulpinus* to these squirrels. He further believes that Schreber accepted Gmelin's translation of "Fuchseichorn" to *Sciurus vulpinus* and used this Latin designation on his Plate 215B, which was issued

TABLE 2

Sciurus niger vulpinus Gmelin

1785. "Fuchseichorn" Schreber, 1785:772. A translation into the German of the term "Fox-Squirrel" in Schoepf's letter to Schreber dated November 3, 1784. Sherborn gives the publication date of this fascicle as 1785.
1788. *Sciurus vulpinus* Gmelin, 1788:147.
1791. *Sciurus vulpinus* Schreber, 1791:pl. 215B. The picture to accompany this fascicle was issued in 1791. The text was published in 1785.
1792. *Sciurus vulpinus* Kerr, 1792:257. In part.
1826. *Sciurus vulpinus* (?) Godman, 1826**:2:**128.
1838. *Sciurus vulpinus* Bachman, 1838:85. A synonym of *Sciurus n. niger* Linnaeus and *S. n. bachmani* (?) Lowery and Davis.
1838. *Sciurus cinereus* Bachman, 1838:89. In part.
1859. *Sciurus vulpinus* Baird, 1859:246. Not a synonym of *S. n. vulpinus* Gmelin but a composite of *S. n. niger* Linnaeus, *S. n. bachmani* Lowery and Davis and possibly others.
1877. *Sciurus niger cinereus* Allen, 1877:717. In part.
1896. *Sciurus ludovicianus vicinus* Bangs, 1896**:10:**150.
1900. *Sciurus ludovicianus neglectus* Nelson, 1900**:13:**169.
1907. *Sciurus niger neglectus* Osgood, 1907**:20:**45. In part.
1944. *Sciurus niger vicinus* Poole, 1944**:25:**315.

in 1791 three years after the appearance of the thirteenth edition of the Systema Naturae. Gmelin's other two citations apply to either *Sciurus niger niger*, or *Sciurus niger bachmani*, or both, but his Latin description is not applicable to either form.

It appears that the correct name for the subspecies of the fox squirrel currently known as *Sciurus niger vicinus* Bangs (1896) is *Sciurus niger vulpinus* Gmelin, 1788 (Table 2).

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OBSERVATIONS ON THE ABUNDANCE, FOOD, AND FEEDING BEHAVIOR OF THE NEWT, *NOTOPHTHALMUS VIRIDESCENS VIRIDESCENS* (RAFINESQUE), IN VIRGINIA

By John Thornton Wood[1] and Ollie King Goodwin[2]

The common eastern newt, *Notophthalmus viridescens viridescens* (Rafinesque) occupies a range extending from "Northern Ontario and height of land in Quebec, southward through the eastern states to Georgia, westward to Alabama and north to northern Illinois and Wisconsin", (Bishop, 1941). Since the species may have economic importance as a predator on mosquitoes, frogs, and fish, its abundance and feeding habits are of interest.

No study of the abundance of the newt has been carried out in any part of Virginia, but the authors have examined specimens from the cities of Alexandria, Hampton and Warwick, and the following counties: Albemarle, Alleghany, Amherst, Augusta, Bland, Buchanan, Buckingham, Caroline, Carroll, Charles City, Fairfax, Fauquier, Giles, Goochland, Highland, James City, Lee, Madison, Middlesex, Montgomery, Nansemond, Nelson, Nottoway, Orange, Princess Anne, Roanoke, Rockbridge, Rockingham, Scott, Shenandoah, Smyth, Spotsylvania, Tazewell, Washington and York. This provides evidence that the species is widespread where suitable habitat is available. Adults are aquatic, and inhabit ponds, lakes, and other permanent water areas having little or no current. Larvae are also aquatic, and share the habitat of the adults, though usually remaining in shallow, marginal waters where they receive some protection from the aquatic predators of deeper water. Juveniles in Virginia are terrestrial, and in some provinces such as the coastal plains they are rarely seen. Evidence that they are not uncommon throughout the state is provided by Bragdon (personal communication, May 21, 1952) who reports that following a heavy thundershower on May 9, 1952 he counted 33 red efts along 1.5 miles of trail in the Shenandoah National Park near Rip Rap Shelter, and the following morning, after heavy showers during the night, 32 specimens were counted in recrossing the same stretch of trail. In the Williamsburg area one mile south of the College of William and Mary a series of approximately 400 adult specimens were collected from two shallow pools, the larger of which was 20 feet long, 10 feet wide, and 15 inches deep. Long series have also been collected from sites in Charles City County and Hampton.

Considerable study has been devoted to the food utilized by the newt. Surface (1913) reports snails are an important item, and that beetles, ants, flies, and vegetable matter are also present. Matheson and Hinman (1929) call attention to the newt as an efficient destroyer of mosquito larvae. Morgan and Grierson (1932) studied the winter habits and the food consumption of adult newts throughout the year. They found that in Massachusetts newts are feeding to some extent during the entire year, and that in the period from January to

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April the stomachs examined contained practically nothing except insect remains. During the rest of the year newts in that area consumed mollusks, crustaceans, plant fragments, and larval newts. This appears to be one of the first references to the vegetarian and cannibalistic feeding behavior of the newt. Hamilton (1940) made an excellent study of the feeding habits of larval newts, and also (1932) published observations on the feeding of adult newts. In the latter paper he observed that "the food and feeding habits of an aquatic vertebrate such as the newt, change as quickly as a group of organisms reach their peak, pass and are replaced by another set". Although this observation suggests indiscriminate feeding by availability, Hamilton (ibid.) provides good evidence of selective feeding in pointing out "in May and June the newts were observed feeding on leeches, midge larvae, caddis worms and small water beetles. . ." and ". . . they appeared to disregard entirely the multitudes of small immature *Corixa*, *Notonecta*, *Odonata*, and *Hydrachnids* that swarmed in the water at the time. Numerous stomach analyses proved this to be correct." These data show that as the organisms available to the newt change with the seasons, the feeding habits of the newt change, but that a high degree of selectivity of food items is present.

In a recent review of the food utilized by the newt, Bishop (1941) lists worms, various insects and their larvae, small amphibians, leeches, small mollusks, crustaceans, and rarely small fish such as the stickleback. Behre (1953) points out a high degree of selectivity in feeding by *Notophthalmus* in eight lakes in the vicinity of Highlands, N. C. She found that stomachs contained little other than a sphaerid tentatively identified as *Pisidium abditum* (Hold.), although this bivalve was not a dominant member of the fauna in the habitats of the newts. This feeding occurred in an area rich in larval and aquatic insects, plentiful vegetation, and doubtless many micro-organisms. The presence of the micro-organisms undoubtedly would have little direct effect on the feeding habits of an aquatic vertebrate whose dentition is modified to serve in omnivorous feeding on macroscopic animals and possibly plants, but the fact that insect remains were absent from the stomach is strong evidence of high selectivity in feeding. The basis for this selectivity has not been explored. It is apparent that if it were related to the degree of movement of objects in the visual field of the newts, the inert bivalves gently raising and lowering their valves in concealment would not have a good chance of being utilized as food. It is probable, then, that smell or taste, (or both), is a directing force in the feeding of newts.

Newts also feed on bivalves in the vicinity of Williamsburg, Va. In April, 1951, an adult newt was collected from Powell Lake, two miles south of the College of William and Mary. It passed mollusk remains in its feces. These were studied by Burch who reported (personal communication, May 10, 1952) the snails as *Fossaria parva* (Lea), the larger being 5.2 x 3.0 mm., and sixteen pill clams, *Musculium rosaceum* (Prime), the largest being 5.5 x 4.0 mm., the smallest, 1.5 x 1.2 mm. This newt was collected in an area in which the mollusks were abundant, but insect larvae and adults, leeches, and many other animals reported to form part of the diet elsewhere were also quite available.

Hamilton (1932) and Bishop (1941) report newts feeding on amphibian eggs. Hamilton mentions the eggs of the spotted salamander, *Ambystoma maculatum* (Shaw), and the wood frog, *Rana sylvatica sylvatica* (Le Conte). Bishop reports newts gorging themselves on the eggs of the mink frog, *Rana septentrionalis* (Baird). In March and April of 1951 and 1952 the authors have noted a large population of newts in two small ponds lacking aquatic vegetation and fauna. The only readily available food supply consisted of amphibian eggs, including those of *Rana clamitans* (Latreille), and the spotted salamander, *Ambystoma maculatum* (Shaw). Egg masses of the latter predominated, and on one occasion 47 discrete masses were counted. As the eggs developed, and the embryos became able to turn actively within the egg envelopes, the authors would note five or six newts resting at the margins of the egg mass. They were clearly attracted by motion. Under laboratory conditions the newts were observed to tear through the thick outer jelly layer on the *Ambystoma* egg mass with their fore-feet, and then snap at the egg envelopes until they ruptured, giving access to the embryos. Embryo and larval *Ambystoma* were eaten without any hesitation by the newts.

In May, 1953, the senior author observed the attacks of newts on their own embryos. Egg-laying and development were being checked in a tank, and the eggs were placed singly in the axils of the leaves of small aquatic plants, or were stuck between the folds of a leaf. When the embryos became large enough to move, the activity was evident through the thin leaf, and the newts were noted to pull at the leaf with their front feet until the embryo was exposed, and then tear the egg up with vigorous snaps of their jaws. The survival advantage of placing the eggs singly, in the case of this species, is suggested by this observation of predation on its own eggs.

Hobbs (personal communication, May 27, 1953) reports the finding of stomachs of newts containing little other than ostracods, tentatively identified as members of the genus *Candona*. These newts came from the Old Reservoir on Observatory Mountain, Charlottesville, Va. where the senior author has had field experience. In this area there is no lack of insect larvae, leeches, worms and other organisms acceptable as food in other areas, thus this is added evidence of selective feeding.

SUMMARY

1. The common eastern newt has a wide distribution in Virginia. Local abundances of adults have been found near Williamsburg, and in Charles City County near Sandy Point and in Hampton, and evidence of a large population of the eft stage was observed in Shenandoah National Park.

2. Newts eat a wide variety of organisms. In Virginia it was noted that snails, pill clams, and ostracods were selected from habitats provided with other foods newts are known to eat. Amphibian eggs were also eaten, including those of the newt, spotted salamander and green frog.

3. Food items selected by the newt may not depend alone upon activity in the field of vision for recognition; chemical stimuli reaching the organs of taste

reception seem to be involved as in the locating of pill clams in the foraging of the newt.

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ON A PROPERTY RELATED TO SEPARABILITY IN METRIC SPACES*

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Every locally separable, connected, metric space is separable [1]. Furthermore every locally separable, metric space is the sum of the elements of a discrete collection[1] of open separable subsets [1]. The sum of uncountably many, mutually exclusive, Euclidean spheres is an example of such a space. If such a space possesses the additional property that every separable subset is countable, then such a space is the sum of countably many discrete subsets. For example, a metric space which is the sum of the *rational* points of uncountably many mutually exclusive Euclidean spheres is the sum of countably many discrete subsets. Recently the author, while working on a problem in abstract spaces, had reason

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[1] A *collection* of mutually exclusive points sets is said to be *discrete* if the sum of the closures of the elements of each subcollection is closed.

to hope that the same would be true without requiring the space to be locally separable. As the following example shows, this hope was ill-founded.

There exists a metric space S in which no countable subset has an uncountable closure but which is not the sum of countably many discrete subsets.[2]

Construction of the space S. The space S shall be the sum of the terms of a well ordered sequence $M_1, M_2, M_3, \cdots, M_z, \cdots$ of mutually exclusive point sets such that (1) for each $z < \omega_1$, M_z is countably infinite, (2) if $x < y < \omega_1$, every point of M_x is a limit point of M_y, but (3) if $x < \omega_1$ has an immediate predecessor, $\sum_{z<x} M_z$ is closed.

In order to show the existence of the sets M_z ($z < \omega_1$) and to define the metric, I shall construct a tree (or graph) which has $\aleph_1$ branching levels and the branch points of the zth level shall constitute the points of M_z. It would be more accurate to say that I shall construct a *class* of trees since at many stages of the construction one of many possible choices is made without specifying the choice exactly.[3]

Let O be a point and G_0 be a countable collection of straight line closed intervals such that (1) if $g_1, g_2 \varepsilon G_0$ then $g_1 \cdot g_2 = 0$, (2) if $g \varepsilon G_0$, the length of g is a rational number between 0 and 1 and (3) if r is a rational number and $0 < r < 1$, there is one and only one element of G_0 whose length is r. Let M_1 denote the set of all free endpoints (*i.e.*, the ones different from O) of elements of G_0. Let G_1 be a countable collection of straight line closed intervals such that (0) if $g \varepsilon G_1$, then $g \cdot M_1$ is degenerate and is an endpoint of g, (1) if $g_1, g_2 \varepsilon G_1$ either g_1 does not intersect g_2 or $g_1 \cdot g_2 \varepsilon M_1$, (2) if $g \varepsilon G_1$, the length of g is a rational number between 0 and 1, and (3) if $m \varepsilon M_1$ and r is a rational number such that $0 < r < 1$, then there is one and only one element g of G_1 whose length is r and $g \cdot M_1 = m$. Ir other words, for each point m of M_1, G_1 contains a subcollection G_{1m} which branches off from m in exactly the same way that G_0 branches off from O, and no element of one G_{1m} intersects an element from another G_{1m}. Let M_2 be the set of free end points of elements of G_1. (Subsequently when distance is defined neither the length nor the internal topology of any element of G_0, G_1, or any G_z will be disturbed.)

This process may be continued a simple infinity of times in the above manner making certain that if $|x - y| > 1$ then $G_x^* \cdot G_y^* = 0$.[4] To define $M\omega_0$, for each point m of M_z ($z < \omega_0$) and for each rational number r ($0 < r < 1$), select a ray starting at m which is composed of the points of an interval g_z of G_z containing m, together with an interval g_{z+1} of G_{z+1} such that $g_z \cdot g_{z+1} \neq 0$, together with an interval g_{z+2} of G_{z+2} such that $g_{z+1} \cdot g_{z+2} \neq 0$, etc., such that the sum of the lengths of these intervals, $g_z, g_{z+1}, g_{z+2}, \cdots$ is the rational number r. Close this ray by adding a point $p(m, r)$ to its open end thus forming a closed interval of length r. (Subsequently when distance is defined, the internal topology of these rays as well as their length will be left unchanged.) Now let $M\omega_0$ denote the set of all

[2] A *point set* is said to be *discrete* if every subset is closed.

[3] The central idea behind this construction is not new. See [3]. But as far as I know, no one has ever thought to set up a metric for such a tree.

[4] If G is a collection of point sets, G^* denotes the logical sum of the elements of G.

such points $p(m, r)$. It is evident that $M\omega_0$ is countable since only one such point p is chosen for each m of $\sum_{z<\omega_0} M_z$ and each rational number r, $0 < r < 1$.

This process may be continued $\aleph_1$ times. For if $z < \omega_1$ and $z - 1$ exists, M_z is defined from M_{z-1} in exactly the same way that M_2 was defined from M_1. And if $z < \omega_1$ but $z - 1$ does not exist, M_z is defined in exactly the same way as $M\omega_0$. Furthermore, for each $z < \omega_1$, G_z is defined from M_z in the same way that G_1 was defined from M_1, and if $| x - y | > 1$, $G_x^* \cdot G_y^* = 0$.

Now let $G = \sum_{z<\omega_1} G_z^*$ and let $S = \sum_{z<\omega_1} M_z$. If p and q are points of G there is only one arc pq in G; so define the distance $d(p, q)$ from p to q as the length of pq. Furthermore, if $p, q \in S$, $d(p, q)$ is rational. The reader may easily verify that G is a locally connected metric space and S is a metric subspace of G.

THEOREM 1. *If M is a countable subset of S, the closure of M is countable.*

Proof. There exists an ordinal x such that $M \subset \sum_{z \leq x} M_z$. Each point p of M_{x+1} lies at some positive rational distance from M_x. If q is a point of M_y $(y > x)$, the arc from q to M_x contains a point p of M_{x+1}; so the distance from q to M_x is not less than the distance from p to M_x and is equal to the distance from q to $\sum_{z \leq x} M_z$. Hence $\sum_{z \leq x} M_z$ is closed. Since each M_z is countable, $\sum_{z \leq x} M_z$ is countable. Therefore the closure of M is countable.

THEOREM 2. *The space S is not the sum of countably many discrete sets.*

Proof. Suppose, on the contrary, that S is the sum of countably many discrete sets: $S_1, S_2, S_3, \cdots$. For each positive integer i and each point p of S_i, there exists a circular region U_p whose center is p and whose radius is less than half of the distance from p to $S_i - p$. Let $Q_i = \{U_p\}_{p \in S_i}$, and let $Q = \Sigma Q_i$. For each i, the regions of Q_i are mutually exclusive. For this reason only countably many elements of Q intersect M_1; so if N_1 denotes the collection of their centers, N_1 is countable. Hence there exists an ordinal x_1 $(x_1 < \omega_1)$ such that $N_1 \subset \sum_{z \leq x_1} M_z$. Again only countably many of the elements of Q intersect $\sum_{z \leq x_1} M_z$ and if N_2 denotes the collection of their centers, N_2 is countable. Hence there exists an ordinal x_2 $(x_1 < x_2 < \omega_1)$ such that $N_2 \subset \sum_{z \leq x_2} M_z$. This process may be continued $\aleph_0$ times. Let $x_n \to x$. Then $x < \omega_1$, and M_x contains a point p. For some i, $p \in S_i$. Hence p is the center of some element U_p of Q. But for some positive integer n, U_p must contain a point of M_{x_n}. Then p belongs to $N_{x_{n+1}}$ which is a contradiction.

THEOREM 3. *The space S is locally peripherally separable (but of course not locally separable).*

Theorem 3 follows from the fact that a circular region centered on a point of S and having an irrational radius has no boundary points. The space G defined in the paragraph immediately preceding Theorem 1 is connected and locally connected but obviously not separable. It follows from [1] that G is not locally separable. Likewise S is not locally separable. Furthermore it follows from [2] that G is not locally peripherally separable. However, the following question seems to remain unanswered:

Question. *Is every connected, locally peripherally separable, metric space separable?*

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A NOTE ON LINEAR SPACES AND UNICOHERENCE

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Eilenberg [1941, theorem 3] has shown that a non-degenerate, connected, locally connected, separable, topological space X is homeomorphic with a subset of the linear continuum if, and only if, $P(X)$ is not connected (where $P(X)$ is the set of points (x, y) of $X \times X$ for which $x \neq y$). This theorem holds without the separable condition if X is a Moore space,[1] which can be demonstrated as follows.

By use of a theorem of Eilenberg [1941, theorem 1], we have the following lemma.

LEMMA. *If X is a non-degenerate, connected, Moore space and $P(X)$ is not connected, then X contains no three points, no one of which separates the other two.*

If X is homeomorphic with a subset of the linear continuum, then, clearly, $P(X)$ is not connected.

If X is a non-degenerate, connected, locally connected, Moore space and $P(X)$ is not connected, then by the above lemma X contains no three points, no one of which separates the other two. Therefore, X is linear[2] and, consequently, by a theorem of Jones [1939, theorem 12], X is a simple continuous curve. But X is not a simple closed curve. Therefore X is homeomorphic with a subset of the linear continuum.

In this section we shall present a theorem on Unicoherence and an example.

THEOREM. *If X is a non unicoherent continuum in a Moore space, then X contains three points, no one of which separates the other two in X.*

Proof. X is non unicoherent. Therefore,

$$X = X_1 + X_2, \quad \text{where } X_1 \text{ and } X_2 \text{ are continua}$$

and

$$X_1 \cdot X_2 = H + K \qquad \text{where } \bar{H} \cdot \bar{K} = 0$$

[1] A Moore space is a space satisfying Axiom 0 and parts (1), (2), and (3) of Axiom 1 of Foundations. For definitions of other terms used in this paper, cf. R. L. Moore (1932), and G. T. Whyburn (1942).

[2] In the sense of Jones, cf. F. B. Jones (1939).

Let x be a point of $X_1 - X_1 \cdot X_2$ and let y be a point of $X_2 - X_1 \cdot X_2$.

$X_x = X_1 - X_1 \cdot X_2 = X - X_2$ is open in X, as is $X_y = X_2 - X_1 \cdot X_2 = X - X_1$.

Therefore, $X - X_1 \cdot X_2 = X - (H + K) = X_x + X_y$, where $\bar{X}_x \cdot X_y = X_x \cdot \bar{X}_y = 0$.

Case I: X_x is not connected, i.e. $X_x = X_x' + X_x''$, where $X_x' \supset x$. But $X_x' + X_2$ and $X_x'' + X_2$ are each connected, otherwise X would not be connected. Let z be a point of X_x''. Then x, y and z are three points, no one of which separates the other two in X.

Case II: X_x is connected. Let z be a boundary point of X_x in H and let w be a boundary point of X_x in K. Then $X_x + z$, $X_x + w$ and X_2 are each connected. Therefore, x, z, and w are three points, no one of which separates the other two in X.

The converse of this theorem is false even in much stronger spaces, as the following example indicates.

Example. There exists a connected, locally connected, complete, unicoherent Moore space X, each point of which separates X uniquely but which contains three points, no one of which separates the other two.

Let X be the unit sphere plus unit segments, in the exterior of the unit sphere, perpendicular to it at each of its points. The distance between two points on one of the perpendicular segments is the Euclidean distance. The distance from a point p on the sphere to a point q on the sphere is the Euclidean distance from p to q. The distance from a point p on the unit sphere to a point a on one of the segments is the Euclidean distance from a to the end point q of the segment a is in plus the distance from p to q. The distance from the point a in one segment to the point b in another segment is the distance from a to q plus the distance from q to p plus the distance from p to b, where q is the end point of the segment a is in and p is the end point of the segment b is in.

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MAGNETIC OBSERVATIONS ON THE SOUTH CAROLINA COASTAL PLAIN

By H. W. Straley, III[1] and W. F. Straley[2]

During the early summer of 1951, the writers made magnetic observations on the South Carolina coastal plain. The area was chosen because an oil-test well at Summerville, South Carolina, had bottomed in a rock thought to be diabase (Cooke, 1936).

Observations were made with an Askania vertical-field balance at intervals of a mile along roadways, distances being measured with an automobile speedometer. The instrument consists of a delicately balanced magnet system so designed that its deflection from a zero point may be read optically. It is mounted on a tripod and oriented, within one-half degree, prependicular to the direction of the magnetic meridian.

Readings must be reduced. Each division of the scale represents a determinable and determined number of gammas. A gamma is 1/10,000 of an oersted, or gauss in the older terminology. Temperature change affects the readings and a suitable correction must be introduced. The magnetic field of the earth varies with geographical position of the observer, as well as with the subsurface distribution of rocks. The geographical variation may be computed and a correction used. Throughout the course of a day, a change is noted in the earth's field at any particular spot, necessitating correction. Occasionally, a place may be observed where the strength of the field is either above or below the range of the particular instrument used. An artificial field, the value of which is known, may be placed at a known orientation with respect to the instrument in order to bring readings back on scale. Whenever this procedure is followed, a correction for the artificial field is indicated.

Map 1 shows a magnetic high (shaded), which it is proposed to call the Summerville High. This parallels the trend of geological structures in the Appalachian mountain system to the northwest and the present Atlantic Coast of North America to the southeast. It appears to decline both southwest of Walterboro and northeast of Monck's Corner, South Carolina. There are, however, indications of possible extension of the magnetic elevation toward both Georgia and northeastern South Carolina.

It may be noted here that the trend of this high passes near other and more pronounced elevations near Wilmington, North Carolina (MacCarthy and Straley, 1937). The significance of the coincidence of trend remains to be determined if and when the northern half of the South Carolina coastal plain is surveyed. Georgia was covered by an unpublished reconaissance survey, made by the United States Bureau of Mines during the late 1930's.

There appears to be little connection between geomagnetic observations and surface geology. The highest portion lies over Duplin (Tertiary) marl. A northward projection, 8 miles west of Summerville, coincides with Duplin. Hawthorne (Tertiary) occupies a larger area than the anomaly.

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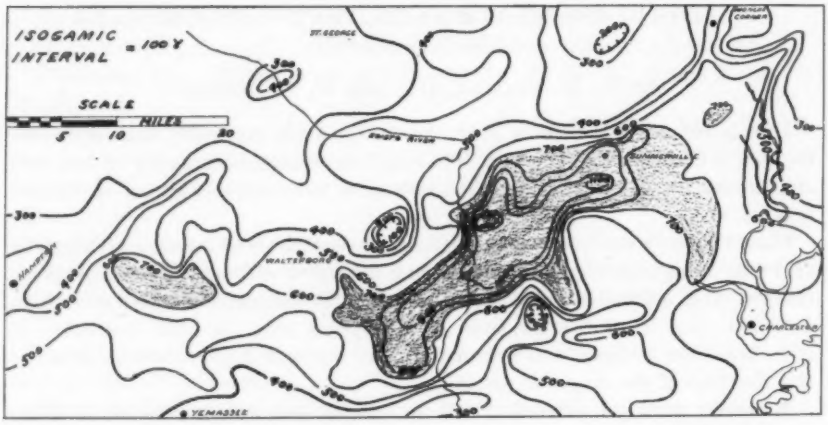

MAP 1. The magnetic field around Summerville, S. C., shown by lines (isopleths, isogams) representing equal magnetic field strength.

The geology of the Carolina coastal plain is simple. At some depth between a few and 4,000 feet below the ground lies a basement complex. It is made of old crystalline rocks similar to those of the Piedmont, to the northwest, of which it is probably a southeasternward extension. Above this basement lies a thin veneer of Mesozoic and Cenozoic sedimentary rocks. They are mostly clays, sands, and impure marls, with an occasional sandstone and one or two limestones. There are fault troughs in the crystalline floor, in which Triassic fanglomerates may have been deposited. These may have been invaded by diabasic igneous intrusions.

In such a geological environment, there are five possible explanations for the Summerville High: (1) a folded iron-bearing member within the coastal-plain sedimentary rocks; (2) diabasic sills within a Triassic fault basin; (3) geological structure in which the basement complex has been brought nearer to the surface of the ground than beneath adjacent areas; (4) an old topographic elevation upon a pre-Cretaceous erosion surface; or (5) geological structure and/or lithological difference within the basement complex itself.

There is nothing within the coastal-plain sedimentary rocks that would normally produce a pronounced magnetic anomaly such as the Summerville High. It is concluded, therefore, that the elevation is not due to an iron-rich member in the coastal-plain stratigraphy.

It may be a Triassic trough. The sedimentary rocks near the bottom of the Summerville oil-test well are Triassic in lithology. The hole probably bottomed in diabase, which is commonly associated with sedimentary rocks deposited in fault troughs of Triassic age. On the contrary, neither shape nor size is that of a Triassic intrusion. Possible northeastern and southwestern continuation of the feature makes such a conclusion improbable. Without more data, particularly relating to its continuation, the suggestion cannot be abandoned. Deep

wells in the area to the southeast should show some interference with underground-water circulation, if the feature represents a Triassic fault trough. Gates (personal communication, 1953) made intensive search through the ground-water literature, but was unable to find evidence on this point.

Structure and/or topography of the basement have been found elsewhere on the Carolina coastal plain. There are granitic knobs protruding through coastal-plain rocks in Pitt County, North Carolina. The Carolina Ridge and the Central Georgia Uplift bring basement toward the surface. Both features are, however, aligned transverse to Appalachian structural trends and are smaller than the extended Summerville High. The isogams are not those of normal topography.

Pre-Appalachian geological structures were often aligned subparallel with subsequent trends. They appear to have been of considerable magnitude along the strike. The writers think it probable that the Summerville High may prove to be a lithologically and/or structurally controlled feature within the crystalline basement complex.

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A NEW SPECIES OF MYRIOTRICHIA HARV. FROM THE COAST OF NORTH CAROLINA

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PLATE 6

On August 1, 1953, while examining some plants of *Diplanthera Wrightii* (Aschers.) Aschers., a tropical-subtropical marine angiosperm, collected in a muddy inlet near Davis, Carteret County, North Carolina, I noticed a minute, filamentous brown alga growing epiphytically on its leaves. Upon further examination, it soon became evident that this alga must be new to this area which lies within the vicinity of the Duke University Marine Laboratory where considerable collecting of marine algae has now been carried on for several years. Having terminal hyaline filaments as well as plurilocular sporangia, it resembled superficially a small species of *Ectocarpus*. After closer examination, however, it was found to differ markedly from this genus, especially in the formation of the hyaline filaments and in its often fascicled, few-locular sporangia.

In attempting to classify this alga with the limited literature available at the time, I was struck by its resemblance to *Myriotrichia occidentalis* described by Børgesen in the *Addenda* (437–440) to his *Marine Algae of the Danish West*

Indies (1920). In making further comparisons, however, it became apparent that, although the two are somewhat similar, the one from North Carolina differed enough fundamentally from the West Indian species to belong to a different taxon.

After consulting the descriptions of all previously described species of *Myriotrichia* it was concluded that the new alga undoubtedly belongs to this genus, but represents an undescribed species. This opinion has been tentatively confirmed by Dr. Papenfuss of the University of California.

Myriotrichia scutata sp. nov.

Fila monosiphonia. Fila erecta ca. 1 mm. longa, divergentia, ad basim rarius ramosa. Fila filamentis hyalinis terminantus, ex quorum basibus rami ariuntur, fere oppositi, interdum alterni. Fila hyalina ad basim crescunt, interdum caduca. Cellulae filorum principalium ca. 11.5 μ latae, 39 μ longae, chromatophoris discoidibus. Sporangia plurilocularia ca. 25 μ lata, 67–90 μ longa, ex 7–10 seriebus composita, fere lateralia, saepe opposita, rarius terminalia; pedicillata, sporangiis secondarius infra nascentibus. Sporangia monolocularia absunt. Fila repentia admodum ramosa in congeriem scutatam congesta.

Filaments monosiphonous. Erect filaments up to 1 mm. long, divergent, with terminal and intercalary growth, branching sparingly below, terminated, where branching, by a hyaline filament; branches similar to the main filaments, often opposite, sometimes terminated by a plurilocular sporangium; cells averaging 11.5 μ wide and 39 μ long, with several discoid chromatophores. Hyaline filaments growing at base, often partly caducous. Plurilocular sporangia mostly on upper portions of erect filaments, mostly lateral, often opposite, or opposite branches, averaging 25 μ wide and 39 μ long, of 7–10 (mostly 7) tiers of cells, some or all of which may be divided vertically into 2–4 (rarely more) cells, stalked with from 1-several cells, the upper usually bearing successively secondary sporangia, forming fascicles. No unilocular sporangia seen. Prostrate filaments richly branching, often bilobed at apex, approximated into a shield-like form, without chromatophores, rhizoids, hyaline branches or plurilocular sporangia.

Material collected by the author August 25, 1953, at Davis, Carteret County, North Carolina, is designated as the type and is deposited in the herbarium at Duke University.

The genus *Myriotrichia* was founded by Harvey (1834), typified by *M. clavaeformis* Harv., a polysiphonous species with numerous short branches, especially upward, to which the generic name alludes. Since that time, seven more species have been assigned to this genus: *M. filiformia* (Griff.) Harv., which is now considered to be only a juvenile form of *M. clavaeformis* (Lund, 1941); *M. repens* (Hauck) Karsakoff; *M. adriatica* Hauck; *M. canariensis* Kütz; *M. Protasperococcus* Berthold; *M. densa* Batters; and *M. occidentalis*

PLATE 6

FIG. 1. Habit of plant of *Myriotrichia scutata*. × 137.

FIGS. 2, 3. Young stages in the development of prostrate branches. × 260.

FIG. 4. Opposite vegetative and reproductive branches. × 390.

FIG. 5. Three stages in the development of hyaline filament and the initiation of branches. × 411.

FIG. 6. Unequal development of opposite branches. × 390.

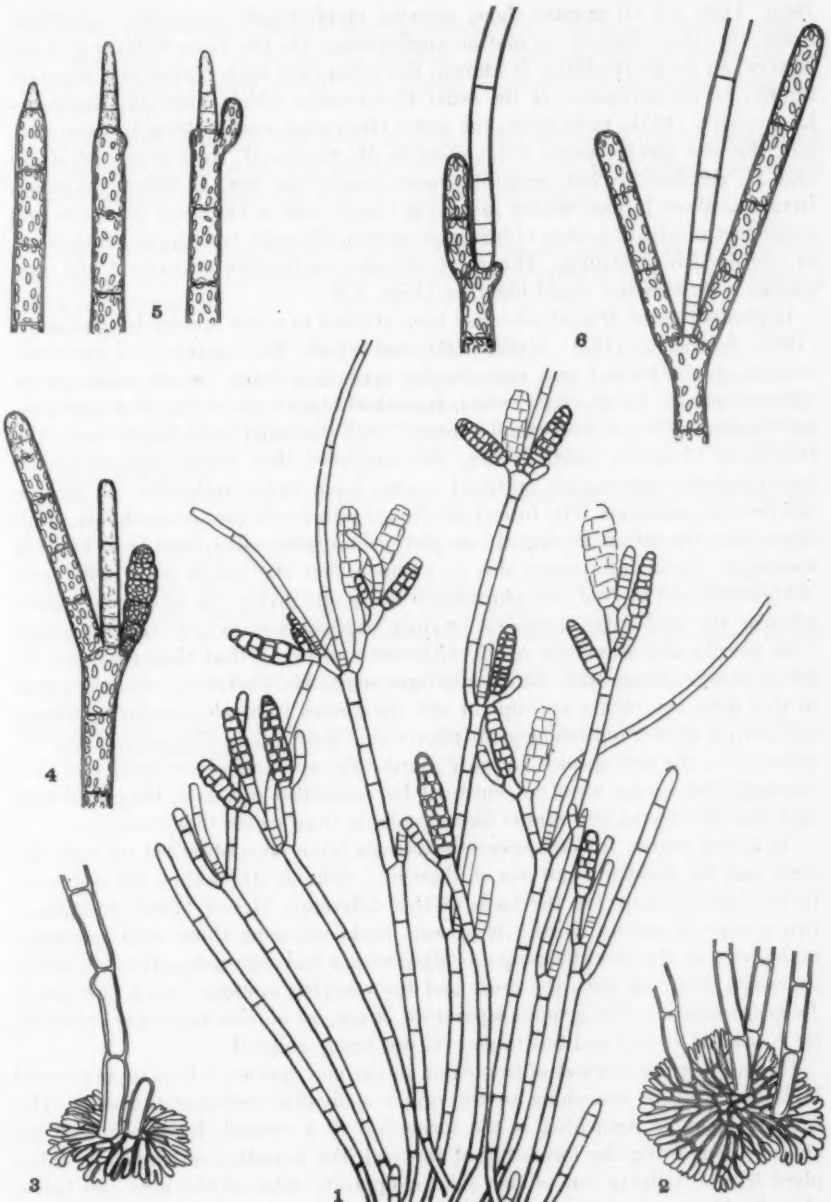

PLATE 6

Børg. They are all minute algae, growing epiphytically, or partly endophytically, on other algae or on marine angiosperms. On the basis of form and life history, so far as the latter is known, this genus has been placed in a separate family, Myriotrichiaceae, of the order Punctariales which, however, Papenfuss has recently (1951) included in the order Dictyosiphonales. Being monosiphonous, the new species seems to be allied to *M. repens*, *M. canariensis*, *M. densa* and *M. occidentalis*, but resembles most closely the last. It differs, however, from this West Indian species in having longer cells in the erect filaments and a compact prostrate system of branches without rhizoids, erect hyaline branches, or plurilocular sporangia. The most obvious, distinctive feature of the new species is its compact shield-like base (Figs. 2, 3).

Reproduction of *Myriotrichia* has been studied in a few species by Karsakoff (1892), Sauvageau (1931), Kylin (1934) and others. The reproductive structures consist of plurilocular and monolocular sporangia borne on the same or on different plants. In *M. clavaeformis*, Karsakoff observed two kinds of plurilocular "sporangia", one with small "spores" and the other with larger ones. The two kinds of spores fused. Hence, she concluded that sexual reproduction is heterogamous. Sauvageau cultured spores from both unilocular as well as plurilocular sporangia. The former developed into sterile plethysmothallia, while those from the latter developed into plethysmothallia which bore both kinds of sporangia. Kylin interpreted this to indicate that the plants with both kinds of sporangia are diploid, the plurilocular sporangia giving rise to diploid spores, whereas the unilocular sporangia produce haploid ones. Kylin cultured spores from plurilocular sporangia of *M. filiformis* and found that they gave rise directly to new plants with plurilocular sporangia. He, therefore, concluded that in this form the plants are diploid and the spores from plurilocular sporangia are neutral spores, reproducing the plants by a short cycle. This seems to be the situation in the new species, for only plurilocular sporangia have been seen and, although the spores were not cultured by controlled methods, they evidently give rise directly to new plants like the plants from which they come.

As stated above, in some species sporangia have been observed on both the erect and the prostrate systems of filaments, while in others they are restricted to the erect system. On the basis of this difference, Hauck (1885) recognized two groups of species worthy of generic rank, retaining those with sporangia exclusively on the erect filaments in *Myriotrichia* and segregating those in which sporangia occur on both the erect and the creeping systems into a new genus *Dichosporangium*. The generic separation of species on this basis was criticized by Karsakoff (ibid.) and has in general not been accepted.

In studying the method of branching in the new species, I became interested in the relation of branching to the origin of hyaline terminal filaments. The first evidence of branching is the formation of a conical, hyaline apical cell (Fig. 5). Following the formation of this cell, the initiation of branching takes place by the bulging out of one side or opposite sides of the next cell below (Fig. 5). If opposite branches are formed, they often do not develop simultaneously but one later than the other (Fig. 6). Since sporangia are reproductive

branches, most of the primary ones develop in the same manner as the vegetative branches (Fig. 4). However, occasionally sporangia appear below the opposite or fascicled ones without any apparent relation to the origin of hyaline filaments (Fig. 1).

Regarding the distribution of *M. scutata*, it may be assumed that it has tropical and subtropical affinities, and is no doubt widely distributed southward, but because of its small size has so far been overlooked.

Grateful thanks are due to Dr. G. F. Papenfuss for his helpful advice and to Drs. F. A. Wolf and Thomas H. Simkins, Jr. for their assistance in preparing the Latin diagnosis.

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NOTES ON NEARCTIC HEPATICAE

VIII. LEJEUNEACEAE HOLOSTIPAE OF NORTH AMERICA[1]

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INTRODUCTION

The subfamily Holostipae of the family Lejeuneaceae is almost completely confined, in North America, to the Southeastern States. It includes those genera which possess a complex stem anatomy, always involving more than seven rows of cortical cells, with the ventral merophytes usually four or more cell-rows broad. Correlated with this, we find usually undivided underleaves, a generally robust size, often brownish to blackish secondary pigmentation, and a group of other, less constant characters. In the past, the major emphasis on the separation of the Holostipae has been on the form of the underleaf. This is readily evident from the names given to the groups, as well as from such sentences as the following: "In der Systematik der Lejeuneaceae spielt die Gliederung nach den Merkmalen der Amphigastrien . . . eine grundlegende Rolle" (Herzog, 1933). However, much discussion has been devoted to the position of a number of holostipous species, of such schizostipous genera as *Ceratolejeunea*, and their position in the Schizostipae has been challenged as, for instance, by Zwickel (1932). The writer would suggest that, in such cases, stem-anatomy be considered as the primary criterion in the reassignation of such difficult taxa.

The only recent publication on the Holostipae, based on the careful studies of Evans, is that by Frye and Clark (1947). These workers list five genera for North America. In the following treatment, seven genera of the Holostipae are listed for North America. Of these genera, only *Leucolejeunea* and *Mastigolejeunea* have been correctly reported as occurring north of peninsular Florida. The report of *Ptychocoleus* from Louisiana by Svihla (1938) is incorrect. The present work extends our knowledge of the range of four of these genera into the non-tropical portions of the Southeast.

1. THE SEPARATION OF THE NEARCTIC GENERA

Although the identification of fertile plants of the holostipous Lejeuneaceae found in North America is usually relatively simple, that of sterile material remains a matter of some difficulty. The extension of the range of the tropical genus *Neurolejeunea* to North America (see Section 2, below) necessitates a revision of existing keys to the group.[2] As a consequence of protracted field work,

[1] The previous paper in this series is: VII. *Lophozia* (*Dilophozia*) *latifolia* sp. nov. The Bryologist **56**: 257–276, pls. I-II, 1953.

[2] The writer would place the largest emphasis on the stem-anatomy in the separation of the Holostipae from other groups. On this basis, as well as on other bases, *Caudalejeunea* clearly must be placed in the Holostipae. Its disposition amongst the schizostipous genera (as in Frye and Clark, 1947) is certainly incorrect.

the writer has had the opportunity to collect every species of the North American Holostipae. Study of living material has shown that a number of readily evident cytological differences between genera exist which had not been previously suspected. These differences make possible the construction of new keys, facilitating the identification of sterile plants.

The keys to genera given in this paper emphasize cytological features. The latter, particularly in the very large and complex family Lejeuneaceae, often offer excellent differential features between genera and sometimes between species. When sterile material is at hand the cytological features (cell-wall and oil-bodies) are in fact among the best criteria we have for the separation of many of these genera. The cytological features of a large number of species of the northern Hemisphere will be dealt with in detail in a paper by Schuster and Hattori (1954), and so need not be treated in further detail here.

KEY TO GENERA OF NEARCTIC HOLOSTIPAE

1. Cell-walls (and consequently plants) more or less golden to brownish to blackish pigmented;[1] each leaf-cell with either 2–4 or many oil-bodies, these appearing homogeneous or formed of coarse globules (segments); perianth never 5-carinate, with dorsal keels 0, or 2–4 ..... 2.
   2. Margin of lobule with 4–7 marginal teeth (formed by 1-several projecting cells); perianth with 6–10 keels (2–4 ventral, 2–4 dorsal, 2 lateral), the keels not dentate or cristate; cells of leaf-margins 12–14 μ, of leaf-middle 16–23 × 22–35 μ; oil-bodies numerous in each cell (7–30 per cell), mostly ellipsoidal to bacilliform, or narrowly fusiform, homogeneous, glistening, highly refractive, minute (2 × 3.5 μ to 1.5–2 × 5–8 μ); underleaves as wide as or wider than long ..... 3.
      3. Oil-bodies 7–12 per median cell; plants developing a golden pigmentation; leaves of normal shoots closely imbricate, subsquarrose; plants developing erect shoots with caducous leaves (these with persistent, squarrose underleaves); fertile plants consistently without subfloral innovations; bracteole *ca.* 900 μ wide; cells with numerous intermediate thickenings ..... *Ptychocoleus*
      3. Oil-bodies 15–30 per median cell; plants fuscous to blackish-brown; leaves flat or nearly so, never squarrose; shoots never with caducous leaves; plants regularly with 1–2 subfloral innovations; bracteole only 350–450 μ wide; cells with few or no intermediate thickenings ..... *Brachiolejeunea*
   2. Margin of lobule lacking any discrete marginal teeth (except for apical tooth, or 1–2 obtuse, undulate teeth); perianths with 3–4 keels (1–2 ventral, 2 lateral, 0 dorsal); caducous leaves not developed; underleaves essentially broadly obcuneate, widest above the middle, the apex rounded-truncate to retuse (except in *Lopholejeunea*) ..... 4.
      4. Cells 14–16 (18) μ on margins, near middle 20–23 × 27–36 (42) μ, thin-walled, except for nodular, bulging trigones, and very numerous intermediate thickenings (1, rarely 2, of which occur between each pair of trigones); cell-walls hyaline (plants thus not with secondary pigmentation); leaf-apices usually more or less acute to subacute; underleaves typically retuse to shallowly emarginate; lobule with apical tooth sharp, usually 3–4 cells long; oil-bodies mostly 20–28 per cell, totally unsegmented, strongly refractive, minute (1.4–1.6 × 3–7 μ); juvenile leaves often producing discoid brood-

[1] Only in *Caudalejeunea* without evident secondary pigmentation.

bodies from antical leaf-surface; perianth strongly flattened, with 2 lateral, 1 ventral keel, the keels unarmed, smooth.....*Caudalejeunea*[4]

4. Cells of leaf-margin 8–10 μ, of leaf-middle 12–20 (28) × 17–28 (32) μ, without distinct intermediate thickenings (but sometimes more or less evenly thick-walled); oil-bodies 2–18, rarely 20, per cell; without any specialized means of asexual reproduction; cell-walls more or less brownish to fuscous; leaf-apices broadly rounded; underleaves truncate to rounded at apex; lobule without a sharp apical tooth (except *Neurolejeunea*).....5.

5. Perianth with 1 ventral, 2 lateral keels; the keels entire or smoothly expanded, never dentate; female bracts and bracteole entire-margined; underleaves about as long as wide or longer than wide, obdeltoid to broadly obcuneate, truncate to rounded truncate at apex, widest usually above middle; cells more or less thick-walled and with distinct to large (but never nodular) trigones; intermediate thickenings absent; oil-bodies mostly ellipsoidal, very large, 3–4.5 × 6–9 μ, 2–3 (4) per cell, formed of very minute to rather large globules; female inflorescence typically innovating on one or both sides, below perianth.....6.

6. Lateral keels of perianth not produced into wings or auricles, the perianth narrowed distally to the terminal beak; underleaves distinctly obdeltoid, truncate distally; lobule with apex poorly marked, without a discrete apical tooth, inflated only along keel, the antical portion pressed flatly against lobe, the apex without a sharply marked opening; dorsal lobe 650–1100 μ long, not strongly notched at juncture of keel and free postical margin of lobe; plants (when mature) ascending in growth, the leaves strongly deflexed when dry; plants black or fuscous throughout; oil-bodies formed of discrete, somewhat protruding spherules.....*Mastigolejeunea*

6. Lateral keels of perianth produced into broad wings, expanded and auriculate above, the beak set in a notch between the distal expansions; underleaves weakly obdeltoid, rounded or rounded-truncate distally; lobule strongly inflated throughout, the anterior margin reflexed, the apex slightly constricted and then flaring to form a circular opening; apex of lobule with a strong curved tooth (evident only on dissection); dorsal lobe 250–350 μ wide × 280–600 μ long, strongly notched at juncture with the ascending keel and widely spreading posterior free margin of lobe; plants decumbent, the leaves nearly flat when dry; plants golden-brown to golden-fuscous, but the juvenile portions of shoots clear green, oil-bodies nearly homogeneous.....*Neurolejeunea*

5. Perianth strongly flattened, with 2 widely separated ventral keels, 2 lateral keels, the keels not auriculate above but armed with teeth or asperations; female bracts (and often bracteole) slightly to sharply dentate on margins; underleaves much wider than long, widest near middle, transversely oval to reniform, broadly and evenly rounded distally; cells more or less thick-walled, with a discrete (more deeply pigmented) middle lamella, walls usually with pits; oil-bodies mostly 8–19 per cell, homogeneous and highly refractive, with age weakly transversely 2–5-segmented, minute (1.5–2 × 3–7 μ); median cells mostly 20–28 × 22–28 μ; female inflorescence usually not subtended by innovations, appearing terminal (never lateral,

[4] This genus is incorrectly placed in the Schizostipae (= Tomiae) in Frye and Clark (l.c.). Both stem-anatomy, underleaf-form, cytology and reproductive features suggest a relationship rather to *Lopholejeunea* and *Mastigolejeunea*.

never in notch between two shoots); lobule without a discrete apical tooth..... *Lopholejeunea*

1. Plants whitish-green to glaucous-green, rarely somewhat yellowish or grayish-green, the cell-walls without any trace of secondary pigmentation; each leaf-cell with typically a single very large oil-body, 18–22 μ long, formed of very numerous, usually unequal, protuberant globules; perianth nearly or quite radially symmetrical, with usually 5 keels (1 dorsal, 2 ventral, 2 lateral), the dorsal keel sometimes obsolete; keels unarmed, undilated; caducous leaves or brood-bodies absent; underleaves orbicular, widest medially; lobule with a single marginal tooth, near apex *Leucolejeunea*

SUPPLEMENTARY KEY TO LIVING STERILE MATERIAL

1. Oil-bodies uniformly 1–4 per cell, large (3–4.5 × 6–9 μ or larger), not homogeneous....2.
   2. Plants without secondary pigmentation, never brownish to blackish; oil-bodies nearly uniformly 1 per cell..... *Leucolejeunea*
   2. Plants brownish to blackish; oil-bodies mostly 2–3 (4) per cell; intermediate thickenings absent.....3.
      3. Oil-bodies obviously segmented or papillose; lobule without a sharp apical tooth; underleaves imbricate..... *Mastigolejeunea*
      3. Oil-bodies finely granulose, almost homogeneous in appearance; lobule with a sharp, curved uniseriate apical tooth; underleaves distant.... *Neurolejeunea*
1. Oil-bodies 7–30 per cell, minute (averaging less than 1.6–2 × 7 μ), homogeneous or (with age) faintly transversely segmented.....4.
   4. Underleaves retuse; plants green: without secondary pigmentation; lobule with a sharp apical tooth 3–4 cells long; juvenile leaves of shoot-apex often with dorsal discoid brood-bodies; oil-bodies 18–28 per cell..... *Caudalejeunea*
   4. Underleaves entire; plants with golden to blackish secondary pigmentation; lobule sometimes with scattered small marginal teeth, but never with a long and sharp apical tooth; never with discoid brood-bodies of juvenile leaves.5.
      5. Lobule with margin with 4–7 small teeth; cells thin-walled, without discrete middle lamella, with nodular trigones (bulging on two sides usually).....6.
         6. Erect caducous-leaved shoots absent; plants blackish, with leaves nearly flat; 15–30 oil-bodies per cell..... *Brachiolejeunea*
         6. Erect caducous-leaved shoots present; plants golden yellow or golden-brown; leaves squarrose or nearly so; 7–12 oil-bodies per cell *Ptychocoleus*
      5. Lobule without discrete marginal teeth; cells more or less thick-walled, the walls with pits, with middle lamella often distinct and darker than rest of wall; plants blackish, flat-leaved, without caducous leaves *Lopholejeunea*

2. NEUROLEJEUNEA (SPRUCE) SCHIFFN. IN NORTH AMERICA

The genus *Neurolejeunea* was first established by Spruce (1884) as a subgenus, *Neuro-Lejeunea*, to include three species, *L. seminervis* Spruce, *L. catenulata* Nees and *L. breutelii* Gottsche. Of these three species the first two possess a group of basal ocelli, oriented in a row to form a "false nerve," giving the group its name. Evans (1907, p. 7) emphasizes that its absence in *N. breutelii* should not necessarily exclude this species from the genus.

The genus, in many respects, stands close to *Ceratolejeunea*, which is generally placed in the Schizostipae, but includes some species that are holostipous. This

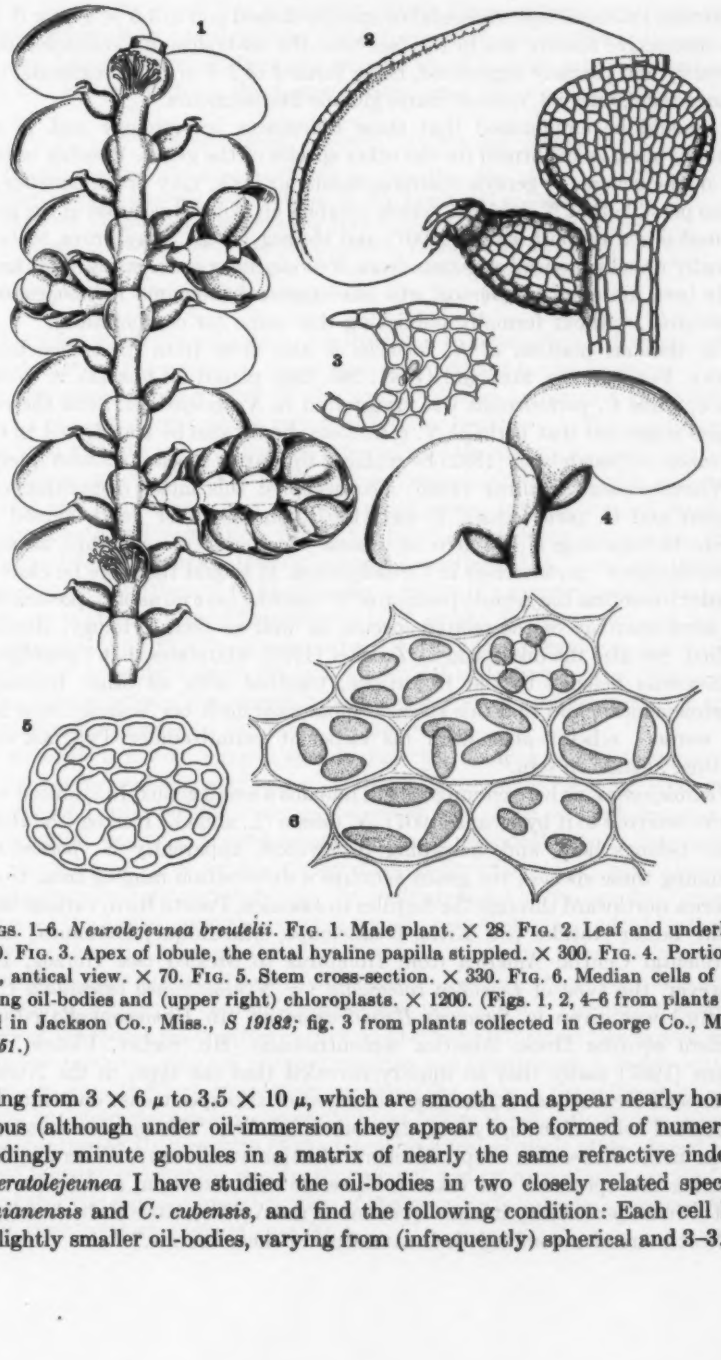
relationship is emphasized by the color, which is brownish to fuscous in both genera, by the sharp apical tooth of the lobule, by the horn-like extensions of the keels of the perianth, and by the frequent presence of a group of basal ocelli. Both genera include species in which these ocelli are abundant and arranged to form a false nerve. Evans (1907, pp. 8, 15) has emphasized that at least one species (*Ceratolejeunea portoricensis*) represents a connecting link between the two genera. According to Evans, *Neurolejeunea* differs from *Ceratolejeunea* in the more or less thick-walled cells, at times with the walls thicker at the angles and the lumen therefore rounded (in *Ceratolejeunea* with the cells with large trigones); in the lobular tooth, which is 2-several cells long, with the hyaline papilla borne distad of the apical tooth, located in the sinus and slightly displaced from the margin (in *Ceratolejeunea* with apical tooth a single cell long, with papilla marginal and proximal to tooth); in the non-inflated horns of the perianth, with the postical keel, when discrete, produced as a single horn (in *Ceratolejeunea* there are four, sometimes five horns, with the postical horn, or horns, as well as the two lateral ones, inflated and gibbose). However, Evans stressed that *C. portoricensis* has equally thick-walled cells, and the writer finds that in *C. cubensis* and *guianensis* the cell-walls are also equally thick, with almost imperceptible trigones, and therefore the features of cell-walls become of doubtful value as a generic character. Furthermore, the size of the apical tooth of the lobule also appears to be too slight to consider as a generic character, although the position of the hyaline papilla appears to represent a significant generic character.

This leaves, as traditional differential characters, only the perianth-form and the position of the hyaline papilla—certainly slight characters on which to base a disposition of one genus into the Holostipae, the other into the Schizostipae. Fortunately, study of the stem-anatomy, by Evans (1935) and by the writer, as well as of the cytology, by the writer, suggests that the similarity between *Nerurolejeunea* and *Ceratolejeunea* is much less marked than was postulated by Evans (1907).

In *N. breutelii* (and presumably in the other species of the genus) the stem is of the typical Holostipous organization—with the cortical cells in many rows, and with the postical merophytes four cells wide (consequently, with the underleaf-bases attached to four rows of stem cells). This is clear both from the discussion and figure in Evans (1935, p. 195; fig. 3C), as well as from the accompanying figures (Figs. 2, 5). Evans does not treat the stem anatomy of *Ceratolejeunea*, but the writer has studied it in *C. guianensis*. In such typical species of *Ceratolejeunea* as *C. guianensis*, with divided underleaves, the stem shows the typical Schizostipous stem anatomy with seven rows of cortical cells, of which two rows belong to the ventral merophytes.[5]

Although the characters of the cell-wall appear to be of quite little value in separating the two genera, the oil-body characteristics of the two groups are very different. In *N. breutelii* there are very large oil-bodies, 2–3, rarely 4 per cell,

[5] This has been determined in material of *C. guianensis* from 8–9 mi. n. of Escatawpa, along Black Creek, Jackson Co., Miss., *Schuster 19184*. This represents the northernmost report of the species (and genus) in North America, and the first for Mississippi.



FIGS. 1–6. *Neurolejeunea breutelii*. FIG. 1. Male plant. × 28. FIG. 2. Leaf and underleaf. × 150. FIG. 3. Apex of lobule, the ental hyaline papilla stippled. × 300. FIG. 4. Portion of shoot, antical view. × 70. FIG. 5. Stem cross-section. × 330. FIG. 6. Median cells of leaf showing oil-bodies and (upper right) chloroplasts. × 1200. (Figs. 1, 2, 4–6 from plants collected in Jackson Co., Miss., *S 19182;* fig. 3 from plants collected in George Co., Miss., *S 26851*.)

varying from 3 × 6 μ to 3.5 × 10 μ, which are smooth and appear nearly homogeneous (although under oil-immersion they appear to be formed of numerous exceedingly minute globules in a matrix of nearly the same refractive index). In *Ceratolejeunea* I have studied the oil-bodies in two closely related species, *C. guianensis* and *C. cubensis*, and find the following condition: Each cell has 2–4 slightly smaller oil-bodies, varying from (infrequently) spherical and 3–3.5 μ

to (usually) more or less ellipsoidal or spindle-shaped and 3–3.5 × 4–5 or 6–10 μ. The distinctive feature lies in the fact that the oil-bodies of *Ceratolejeunea* are obviously and coarsely segmented, being formed of 2–6 or more segments, often arranged in 2, rarely 3, rows of coarse globule-like segments.

It should be emphasized that these differences in cytology and in stem anatomy must be confirmed for the other species of the genus. Possibly redefinition of the genera, or generic rearrangements, or both, may prove necessary. It is also possible that *N. breutelii*, which occupies an isolated position in the genus, as emphasized by both Evans (1907) and Herzog (1933), may prove to be generically or subgenerically discrete from *Neurolejeunea* sens. strict. This has already been hinted at by Herzog, who has suggested the name *Triotolejeunea* for *N. breutelii*, without formally publishing this name (or combination).

The dubious position of *N. breutelii* is also clear from its nomenclatorial history. For instance, Stephani (1888: 283, 288) placed *N. breutelii* in *Ceratolejeunea*, while *C. portoricensis* was transferred to *Neurolejeunea*. Soon thereafter he also suggested that perhaps *N. catenulata* should also be transferred to *Ceratolejeunea*, although later (1892) he replaced this latter species, without question, in *Neurolejeunea*. Schiffner (1895) also accepted this latter disposition of *N. breutelii* and *C. portoricensis*. Evans (1907), on the other hand, agreed with Spruce in regarding *N. breutelii* as a *bona fide Neurolejeunea*, while he placed "*Neurolejeunea*" *portoricensis* in *Ceratolejeunea*. It should therefore be clear that in order to confirm the generic position of *N. breutelii* (as well as of *C. portoricensis*) the stem-anatomy of the related species, as well as their cytology, should be studied. See also the discussion by Zwickel (1932) who states that *Ceratolejeunea portoricensis* belongs to the Holostipae, together with all other holostipous Ceratolejeuneae, and that this species "muss zwar noch bei *Neurolejeunea* belassen werden, scheint aber doch als vielleicht vermittelnder Typ, als eigene Gattung anzusehen sein."

Neurolejeunea, as here circumscribed, remains a small genus. In addition to the species referred to it by Evans (1907), *N. devexa* (L. and G.) Herzog (see Herzog, 1933) belongs here, and, according to Zwickel, apparently *N. portoricensis*. Including these species, the genus acquires a distribution ranging from tropical America northward through the Antilles to Jamaica, Puerto Rico, various islands of the Lesser Antilles (St. Kitts, Guadeloupe, Martinique, Dominica) and in continental Central America from Honduras to Mexico (see Herzog, 1933). However, the type of *Lejeunea catenulata* (= *Neurolejeunea catenulata* (Nees) Schiffn.) was given in *Synopsis Hepaticarum* as "In *Hymenophylla ciliato* et *Neckera abietina* Hook. America septentrionalis (Hb. Sieber, Flotov., N.)." Evans (1907) states that an inquiry revealed that the type, in the Nees von Essenbeck Herbarium, Strassburg, consisted of two specimens: one from Java, associated with *Hymnophyllum;* the other labelled "*Phragmicoma catenulata* N. ex herb. Sieber Am. Sept. Neckera abietina v. Flotow." Where in North America this specimen was taken is therefore still uncertain, and Evans states that: "In all probability it came from one of the Antilles, since Sieber's collectors in North America confined their attention to these islands."

The definite report of this genus from North America therefore marks an important addition to our Hepaticae flora. Even more remarkable is the fact that the only report comes not from the tropical tip of Florida, where one might expect this genus, but from the Lower Austral zone of coastal Mississippi.

Neurolejeunea breutelii (Gottsche) Evans

Lejeunea breutelii Gottsche, *in* G.L. & N., Syn. Hep. 324, 1845.
Symbiezidium breutelii Trevis., Mem. R. Ist. Lomb. III **4**: 403, 1877.
Lejeunea (*Neuro-Lejeunea*) *breutelii* Spruce, Hep. Amaz. et And. **84**: 1884.
Lejeunea (*Ceratolejeunea*) *breutelii* Stephani, Hedwigia **27**: 283, 1888.
Ceratolejeunea breutelii Schiffner, *in* Engler-Prantl. Nat. Pflanzenfam. 1(3): 125, 1895.
Neurolejeunea breutelii Evans, Bull. Torr. Bot. Club **34**: 13, 1907.

This species, like its congeners, is a species of tropical affinity. Evans (1907, p. 8) characterizes the genus as: ". . . apparently confined to the American Tropics. Its three species usually grow on the trunks of trees or rotten logs, sometimes forming pure mats, sometimes mixed with other hepatics . . . The species appear to be most at home in moist forests, especially on the lower slopes of mountains." The present species is locally uniformly corticolous, and grows with widespread tropical and subtropical species. The range given for the species by Evans (*l.c.*, pp. 14–15) is Puerto Rico, St. Kitts (type), Guadeloupe, Dominica, Martinique, and Jamaica, while Herzog extends it northward to Honduras (with the range extended northward to Mexico, if we follow the suggestion of Herzog that *N. devexa* is at best a geographical race of *N. breutelii*). Its occurrence in Cuba and conceivably in Florida is to be expected, since the present gap in its known distribution possibly reflects the lack of critical collecting, rather than a truly disjunct distribution. The present report is certainly of interest in that it marks the northernmost edge of the range of the genus.

N. breutelii is a very distinct species, differing at once from its congeners in lacking the "nerve" or row of paracysts that give the genus its name. The species has obdeltoid suborbicular underleaves, much like those of *Lopholejeunea* and *Leucolejeunea;* however, it exhibits only a remote relationship with these genera. The plants are a more or less glossy fuscous-brownish color, with the walls showing characteristic pigmentation; the walls are more or less evenly thickened, more so at the angles, with the trigones usually rather obscure and without trace of intermediate thickenings; the middle lamella is obscure. The distinctive oil-bodies are somewhat like those of *Mastigolejeunea* (to which the more or less thick-walled, pigmented cell-walls also superficially ally it). The most distinctive feature of the sterile plant is the leaf-form: The relatively small lobule is strongly inflated throughout, with the anterior margins and apical tooth invisible without dissection, since they are so strongly involute; the apex of the inflated lobule is slightly but characteristically constricted just before the slightly flaring, circular distal opening; at the juncture of the lobule and free portion of the dorsal lobe, the leaf is characteristically, deeply, sharply notched on its posterior margin, and beyond this the rounded apical portion of the strongly falcate dorsal lobe spreads widely, usually at an angle of over 90°.

The brownish color, form of the oil-bodies, and unlobed underleaves separate the genus from our other Lejeuneaceae, except for *Mastigolejeunea*. It differs from *Mastigolejeunea* in its smaller size, its uniformly prostrate growth (secondary axes more or less ascending in *Mastigolejeunea*), and in the fuscous-brownish rather than blackish pigmentation. The distant, shorter underleaves (fully as wide as long), the very strongly inflated, characteristic lobule, and the sharp notch along the posterior leaf-margin, at once separate sterile plants from those of *Mastigolejeunea*. Fertile plants differ in that the perianth bears two broad lateral wings, dilated anteriorly into rounded, auriculate lobes, between which the beak is set in a deep notch. *Neurolejeunea* is characterized by the presence of a discrete, curved, spinous apical tooth of the lobule, usually 2, occasionally 3 cells long (and 1–2 cells wide). The hyaline papilla, as pointed out by Evans, occurs on the inner (dorsal) surface of the lobule, near the distal base of the apical tooth. *Mastigolejeunea*, in contrast, shows much variation in form of the lobule, and the apical tooth is most often poorly marked, never spinous and curved. Furthermore, the hyaline papilla is proximal in position, although often slightly entally displaced.

The cells and oil-bodies of this species are diagnostic. The cell-walls are distinctly thickened, brownish pigmented, and possess no intermediate thickenings; the trigones, however, are moderately distinct, though not sharply marked because of the general thickening of the cell-wall; they are occasionally large enough to become almost bulging in the local material (unlike those figured and described by Evans, 1907). The oil-bodies occur mostly 2–4 per cell, in median leaf cells, and are very large (relative to the small size of the cell), thus very largely obscuring the cell-lumen. They are mostly ovoid to ellipsoid and range from 3 × 6 μ, short-ellipsoid, to 3 × 8 μ, elongate-ellipsoid, rarely 3.5 × 10 μ. In a few cells they number 4–5 per cell, are somewhat smaller and nearly spherical, and then measure only 3.5–4 μ; they appear nearly homogeneous even under oil-immersion, showing only obscure traces of their vesicular structure; their surface appears virtually smooth. The chloroplasts in the latter type of cell are about equal to them in size, or even slightly larger, averaging 4.5 μ; in cells with the fewer and larger oil-body complement, they are as wide as or wider than the oil-body, but much shorter, hence smaller. The chloroplasts, like the oil-bodies, are very few, only 4–7 being visible per cell, on the outer face.

The stems of this species were described by Evans (1935, pp. 195–196, fig. 3 C–G). Evans' and my observations agree as follows: The stems show at best a slight differentiation into cortex and medulla, the cortical cells being slightly more pachydermous; all cells are more or less brownish pigmented, the medullary scarcely less deeply so than the cortical. The plants studied by Evans (perhaps female plants?) appear to have been considerably more robust than the male plants I studied: Size of stem *ca.* 150 μ wide × 120 μ high (90 × 65 μ in the Mississippi plants); cortical cells in *ca.* 18 rows, and 10–20 μ wide × 10–15 μ thick, their external walls *ca.* 4 μ thick (in 15–16 rows in Mississippi plants, 9–15 μ wide × 7–9 μ thick, the external wall only 2–3 μ thick); medullary cells *ca.* 12 μ, occasionally up to 20 μ wide (in the present material 12–15 μ). In Evans'

plants, the medulla was usually 5 cell-rows high; in the present plants it was almost uniformly 4 cell-rows high. These discrepancies in the number of cell-rows which constitute the stem, as well as their size, may be due to heterothallism, but may indicate that the United States material represents a slighter, more reduced race or perhaps discrete species. Nomenclatorial recognition of such a type must accompany proof of differences of a more profound nature.

Neurolejeunea breutelii has been excellently described and illustrated by Evans (1907), except for the male plant, details of the leaf, and the cytological features. The accompanying plate supplements the illustrations given by the latter author. The discussion by Herzog (1933), particularly with reference to the perianth, is also very useful.

NORTH AMERICAN DISTRIBUTION AND ECOLOGY: The author has found *N. breutelii* twice in North America; at each of the two stations the species is abundant, often forming extensive blackish mats, especially at the bases of trees and on the exposed, flaring juncture between stem and roots.

MISSISSIPPI: JACKSON CO.: Over bark of *Nyssa sylvatica* var. *biflora*, along Black Creek, 8–9 miles n. of Escatawpa, along Route 63, July 23, 1951 (*S 19182*);[6] same data, April 4, 1953 (*S 26801*). GEORGE CO.: Over bark of *Magnolia grandiflora*, Wyatt Hills, n.e. of Ramsey Springs, April 5, 1953 (*S 26851*); same data, but over bark of Beech, with *Radula australis* (*S 27620a*); same data, but with *Cololejeunea contractiloba* (*S 27620*); same data, but with *Radula obconica* (*S 27620b*).

The two above occurrences are from radically different ecological sites. In Jackson County the species occurs in swampy woods along a slow moving creek, the arborescent vegetation largely formed by *Nyssa sylvatica biflora*, *Cyrilla racemiflora*, *Cliftonia monophylla*, *Chamaecyparis thyoides*, *Taxodium distichum*, *Persea palustris*, and *Magnolia virginiana*. Associated on bark here are, characteristically, such subtropical and tropical hepaticae as *Mastigolejeunea auriculata*—but also (on bark) the relatively northern *Bazzania trilobata*. At this site also occurs the tropical and subtropical epiphytic orchid, *Epidendrum conopseum*. This has not previously been reported from Mississippi; it occurs here at the northernmost edge of its Gulf Coast range.

By contrast, at the George County station, the species is found in rich Beech-Magnolia forest, with the tree-canopy formed largely by *Pinus taeda*, *Fagus grandifolia*, *Morus rubra*, *Cercis canadensis*, *Magnolia macrophylla*, *cordata*, *pyramidata*, *grandiflora*, *virginiana*, *Liriodendron tulipifera*, *Oxydendrum arboreum*, *Quercus* spp., and *Carya*. Associated understory trees and shrubs are *Ilex opaca*, *Cornus florida*, *Ilicium floridanum*, *Kalmia latifolia*, *Azalea canescens*, *Stewartia malachodendron*. The list of associated hepatics (*Cololejeunea contractiloba*,[7] *Ceratolejeunea guianensis*,[8] *Mastigolejeunea auriculata*,[9] *Radula australis*, *andicola*, *caloosiensis*) consists largely of species of tropical affinity.

[6] The collection numbers are those of the writer; the abbreviation *S* is used throughout for Schuster.

[7] Previously reported only from Southern and Central Florida.

[8] Previously reported from Florida and the southern tip of Louisiana.

[9] Previously reported from Florida to Alabama, and southern Louisiana.

Yet these species occur here with such species of Appalachian affinity as *Magnolia pyramidata*,[10] *M. macrophylla*, *M. cordata*,[11] *Kalmia latifolia*, *Oxydendrum arboreum*, *Cercis canadensis*, *Fagus grandifolia*. The mingling, at this latter station, of such a clear-cut tropical element as *Neurolejeunea breutelii* and such essentially appalachian groups as *Kalmia*, *Oxydendrum* and the deciduous-leaved species of *Magnolia* is phytogeographically exceedingly significant. The possibility that these areas represent refugia of an ancient, pre-Pleistocene forest type cannot be ruled out, even though the history of this forest type is at present very problematical. Further study may demonstrate that the Beech-Magnolia forests of the coastal portions of southeastern United States represent a remnant of a Tertiary forest type, as old as is the Appalachian Mixed Mesophytic Forest. Should this hypothesis prove tenable, the presence of *Neurolejeunea* in this forest type, but not in tropical Florida, becomes much more easily explicable.

The presence in this type of forest at Van Cleave, Miss., nearby, of typical *Magnolia tripetala*, some 300-odd miles southwest of the nearest reported site (northern Alabama) can also be explained most easily on the assumption that the Beech-Magnolia forest type represents an ancient (and today localized) climax. Similarly, the extremely restricted occurrence, under very nearly identical conditions, of *Taxus floridana* and *Torreya taxifolia* (along the Appalachicola River in western Florida) is compatible with such a hypothesis.

3. Ptychocoleus in North America

The essentially tropical genus *Ptychocoleus* was first shown to be represented in continental North America in the admirably detailed discussion of *P. heterophyllus* Evans, by Evans (1918, 1922). The study of this species, in Evans (*l.c.*), is so thorough that little can be added here, except for a description of the cytological features of the leaf-cells:

> Cells of leaf-middle somewhat elongate-hexagonal, 20–24 × 25–35 μ, the walls very irregular, owing to the presence of the large trigones (which normally have two sides bulging, the third concave, thus walls irregular and undulate in shape), and of the commonly present intermediate thickenings (usually occurring 1 between each pair of trigones, but absent on most shorter walls); cell walls thus strongly undulate, yellowish to yellowish-brown (except in the shade form, where the walls are colorless).
>
> Oil-bodies 7–12 per median cell, homogeneous, glistening, colorless, bacilliform to narrowly fusiform, 2 × 3.5–2 × 5 μ, occasionally up to 2 × 8 μ, in a few cells ovoid to broad-ellipsoid and 2.5 × 3 μ to 3 μ. Marginal cells with oil-bodies usually smaller, mostly nearly spherical.

Since this species was described, it has been reported from Honduras (Evans, 1918) and Nicaragua (Evans, 1922). It was described from material collected about 8 miles south of Sanford, Florida, and has not subsequently been reported from Florida. McFarlin (1940) reports it only from Seminole County, Florida,

[10] In the writer's opinion, this latter should at most be regarded as a subspecies of the Appalachian *M. fraseri*.

[11] *M. cordata* very probably represents only a subspecies of the Appalachian *M. acuminata*.

evidently referring to the original citation of the species (in Evans). The writer can add numerous further stations for the species, all from Florida, as follows:

FLORIDA: LAKE CO.: Alexander Springs, s. of Astor Park, Ocala National Forest, *S 31518*, Dec. 1953, on bark of *Quercus virginiana*; same data, *S 31519*, on bark of *Quercus laevis*. MARION CO.: On bark, along e. bank of Oklawaha River, at intersection of Route 40, *ca.* 5 miles e. of Silver Springs, *S 25621*, Dec. 1951; on bark of *Persea borbonia*, Juniper Springs, Ocala National Forest, *S 25789*, Dec. 1951; *S 26398*, Dec. 1952; Juniper Springs, Ocala National Forest, *S 31581*, on bark of *Sabal palmetto*; same data, *S 31586*, on bark of *Quercus nigra*; same data, *S 31588*, on bark of *Quercus virginiana*; same data, *S 31596*, on bark of *Quercus laevis*. HILLSBOROUGH CO.: On bark of *Quercus virginiana*, Hillsborough River State Park, *S 25984*, Dec. 1951.

The ecology of this species is very interesting, and appears to have been quite uninvestigated. In the experience of the writer, the species occurs both in deep hammock forests and in open turkey-oak forests. It is, in fact, somewhat less frequent on shaded, damp bark in the hammocks than on dry, exposed, somewhat insolated bark in open oak woods. In the rich and mesophytic hammock forests, it has been found on bark of *Quercus nigra*, *Persea borbonia*, and even (a single time) on that of the cabbage-palm, *Sabal palmetto*. The more frequent occurrences, in oak forests peripheral to the hammock-forests, are almost always on either live-oak (*Q. virginiana*) or on turkey-oak (*Q. laevis*). When on the latter hosts, the species is a very pronounced xerophyte, occurring with *Frullania kunzei* and *obcordata*, *Leucolejeunea conchifolia* and *unciloba*, *Microlejeunea bullata* and *Cololejeunea minutissima*.

The five known stations for the species from Florida outline a triangle which lies essentially within the so-called "Oligocene Island" Region. Several thousand collections made by the writer in the more strictly tropical region south and west of Miami have not revealed the presence of the species there. It is therefore postulated that this species represents one of a number of plants known from the relatively old land-mass of central-western Florida, but not found elsewhere in North America. This distribution, it should be emphasized, is quite without a previously known parallel in the hepaticae, and therefore of special interest. Small (1938) clearly emphasizes the fact that certain ferns also appear to show a similar distribution pattern, occurring in Central America, in the Antilles, and in central Florida, but not in the tropical portions of the state. It is suggested that, as is the case with the ferns cited by Small, we deal with so-called "old tropical species," which invaded Florida in pre-Pleistocene times, but have not again migrated to Florida in more recent times.[12]

Ptychocoleus heterophyllus does not appear to be the only hepatic with an apparent restriction in distribution (in Florida) to the Oligocene Island Region. Into the same category fall, apparently, the following species:

Dumortiera nepalensis. Known in the United States only from a single station in Georgia and two unpublished personal collections made in the Escarpment

[12] The species has also been reported from Louisiana (Bateman's Island) by Svihla (1939). This evidently represents an error, judging from a reprint in the author's possession, in which this is corrected to *Lophocolea heterophylla*.

Region of the Southern Appalachians in North Carolina; in Florida known from near Gainesville, Allachua Co. and from a personal, unpublished collection at Pineola, Citrus Co.

Clasmatocolea doellingeri. Known previously from Polk Co. and Seminole Co., with unpublished personal reports from Lake Co. and Marion Co.; all lying in or at the periphery of the Oligocene Island region.

Stylolejeunea spiniloba. Known from Hillsborough Co. and Seminole Co., and somewhat to the south of the Oligocene "Island" in Charlotte Co.

Drepanolejeunea bidens. Previously known in the United States only from the Southern Appalachians, from Virginia to North Carolina and Tennessee; personal, unpublished collections of the species establish it as occurring in a portion of the Old Oligocene Island region of Florida, from Marion Co. and Lake Co., northward to Clay Co., as well as in coastal Mississippi. The Appalachian and Coastal Plain populations differ taxonomically, and probably represent distinct, but closely allied taxa. This problem will be dealt with in another paper.

Crossotolejeunea bermudiana. Known in Florida from Seminole Co. and Lake Co.; elsewhere from the Southern Appalachians in Tennessee (Sharp, 1939) and coastal North Carolina and Mississippi (Schuster; unpublished data).

The distribution of these species suggests the existence of a well-defined group of species restricted, in Florida, to the Oligocene Island Region. Some are ancient species, also occurring in isolated stations in the Southern Appalachians (*Crossotolejeunea*, *Dumortiera nepalensis*), and evidently of wider Tertiary distribution.[13] Others (*Stylolejeunea*, *Clasmatocolea*, *Ptychocoleus*) are absent from north of the Florida peninsula. Presumably these represent examples of the "Old Tropical" species of Small (1938).

The restricted distribution patterns exhibited by this species of *Ptychocoleus* and the other enumerated species are particularly pertinent, since Redfearn (1952) has recently stated: "Another possible source of tropical bryophytes in central and southern Florida is the Oligocene Island which has remained continuously above sea level since Oligocene times. Prior to the Oligocene . . . this land was connected to the western portion of the Antilla and was one into which early tropical and tropical lowland floras could migrate. . . . Unfortunately, bryophytes have not been collected extensively enough in this area to establish any definite relationships." The few cases cited above suggest that the species of "Old Tropical," presumably Tertiary or even pre-Tertiary origin have not to any great extent broadened their range in geologically recent times. The connection established between the Oligocene Island of Florida, and the Southern Appalachians (by the presence, in common, of such species as *Crossotolejeunea bermudiana*, *Dumortiera nepalensis*, *Calypogeia* sp., *Drepanolejeunea bidens*, which are largely absent in the intervening area) is suggestive, and will be dealt with in another paper.

[13] A clear-cut related case is that of a new species of *Calypogeia* (to be published in another connection), which occurs in the Oligocene Island Region (Marion, Lake and Seminole Counties), and then again in the Escarpment Region of the Southern Appalachians (in North and South Carolina). This species is related to the tropical *C. portoricense*.

4. LOPHOLEJEUNEA IN NORTH CAROLINA

The genus *Lopholejeunea* is described by Frye and Clark (1947) as being "all tropical or subtropical, persisting but little beyond frost free regions." In North America, the genus has been reported from Central and Southern Florida, not extending north of the peninsula. Here both *L. muelleriana* and *sagreana* are frequent, and have been collected from a variety of localities by the writer. Aware of the essentially tropical distribution of the genus, the writer was extremely surprised to find material of *L. muelleriana* (Gottsche) Schiffner in North Carolina, in a lower Austral environment.

The North Carolina collection is from a primal *Nyssa aquatica-Taxodium distichum* swamp, with *Acer rubrum* and *Planera aquatica* as accessory, largely understory, trees. *Quercus laurifolia* is the only oak present. At this station, situated 1.5 miles east of Whiteville, Columbus Co., a very small quantity of *Lopholejeunea* was found on August 15, 1953 (*Schuster & Blomquist 29200*), on the bark of *Nyssa aquatica*. Associated were *Euosmolejeunea duriuscula*, *Rectolejeunea maxonii*, *Leucolejeunea clypeata*, *Frullania kunzei*, *Radula caloosiensis*, and an undescribed species of *Plagiochila*. *Euosmolejeunea* and *Radula* represent subtropical and tropical species, not before reported from the state. On October 23, 1953, a special trip was made again to the same station, and careful search resulted in finding two more colonies of the species (also on *Nyssa*), both of which were of considerable extent. (*Schuster, Blomquist & Bryan 29898*). Associated were the above species, and also *Lejeunea flava* and *Frullania obcordata*, as well as (on one tree) the fern *Polypodium polypodiodes*, and the subtropical orchid *Epidendrum conopseum*. It deserves emphasis that the latter (as well as the genus *Lopholejeunea*) is here at the northernmost known limital point in the known distribution of the genus.

The blackish color of *Lopholejeunea muelleriana* (when in mats, in the shade, with an almost bluish-black cast) is distinctive. Evans (1907, 1908) gives a detailed account of this species.

To this discussion the writer can add only his observations on the living plants. In both *L. muelleriana* (as well as in the more strictly tropical *L. subfusca* = *sagreana*) the cells bear oil-bodies that are similar to those occurring in *Ptychocoleus*, as well as those of the strictly tropical genera *Brachiolejeunea* and *Caudalejeunea*. These are homogeneous, at most faintly transversely barred with age, much as in *Nardia scalaris*. They are also very small, glistening, usually narrowly ellipsoidal to fusiform in shape, although occasionally shorter. In most median cells they number 8–20 per cell, and average 1.5–2 × 3–7 μ in size. It deserves emphasis that neither in *Lopholejeunea*, nor in the aforementioned related genera with homogeneous, small, numerous oil-bodies, do ocelli ever appear to occur. The writer would suggest that these genera show a high degree of relationship to each other, and stand isolated from those genera (*Neurolejeunea*, *Mastigolejeunea*, *Leucolejeunea*) in which there are few, large, and salient, more or less distinctly segmented oil-bodies. By this the author does not mean to imply that the latter group of genera are closely related; the converse appears to be the case.

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SARRACENIA LEUCOPHYLLA RAFINESQUE

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As briefly pointed out by Wherry (1934) the name *Sarracenia leucophylla* Raf. has many years' priority over *S. Drummondii* Croom. It is probable that Croom (1848) was unaware of Rafinesque's earlier description of these plant since he made no mention of it. Earlier than either of these two names, however, was one proposed by William Bartram (1791) for what may have been plants of *S. leucophylla*. Although the location was correct for this species, Bartram's description of *S. lacunosa*, as he called the plants, fits *S. minor* perfectly; and *S. minor*, which does not grow as far west as Pensacola, had previously been described by Walter in 1788. Bartram's name for the plants in question is at best a *nomen confusum* and consequently has never been accepted for either of the two species for which it might have been intended. Actually, as pointed out by Rickett (1944), none of the names proposed by Bartram in his "Travels" are acceptable under our present code since Bartram did not consistently employ binary nomenclature throughout this publication.

The previous non-acceptance of the next name in line of priority, *Sarracenia leucophylla* Raf., seems to stem from two ideas. The first is one which started with the contemporaries of Rafinesque and which is still with us, namely, the mistaken idea that the name is not valid because, as once stated by Harper (1918, page 121), it ". . . has never been taken seriously on account of Rafinesque's well-known eccentricity. . . ." The second idea, which goes back over half a century and which is also still with us, questions the validity of the name because of certain aspects of its application. There appears to be no basis in the letter or the spirit of the International Code for the continuance of the first idea, while recent comparison and study of both Robin's (1807) "Flore Louisianaise" and Rafinesque's somewhat notorious translation and "improvement" of it (1817) have thrown some light on the actual status of the name *S. leucophylla* Raf. This name has not previously been accepted by the monographers of the genus *Sarracenia*, and is listed in the Kew index as a questionable synonym of *S. Drummondii* Croom. In addition, *S. leucophylla* Raf. is listed by Merrill (1949) with what appears to be a pre-Rafinesque name (*"Ratpathe velu"*) applied to the plants by Robin (loc. cit.).

Although Harper (1918) may have considered Robin's description of the new "arum" he saw near Pensacola to be incomplete because no mention is made of the flowers, Robin gives an excellent two page description of the most diagnostic characters (i.e. leaf characters) of what Rafinesque later named *Sarracenia leucophylla*. This description is not in "Flore Louisianaise" proper but appears on pages 48 to 50 of volume two of Robin's three volume work "Voyages dans l'intérieur de la Louisiane" (of which "Flore Louisianaise" is only the last part of volume three). Robin's two page description, plus some further descriptive material, such as "spathe velu", concerning these plants in the "Flore Louisian-

aise" proper furnishes the descriptive material for Rafinesque's diagnostic and unmistakable description of *S. leucophylla* in his translation.

On page ten, in the preamble to his "Florula Ludoviciana", Rafinesque lists several plants that ". . . deserve cultivation . . . for the elegance of their forms. . . ." In this list occurs for the first time the name *Sarracenia leucophylla*. These plants were described by Rafinesque on page fourteen of the work cited where they were placed under "Order I.—Aroides." as they were in Robin's (1807) original work. Rafinesque's complete entry for *S. leucophylla* at this point is as follows:

> "17. *Sarracenia leucophylla* Raf. Foliis tubulosis, strictis, elongatus, teretis, albo coloratis, rubro venatis, intus retrorsum hirsutis, fauce undulata, appendice fimbriata dilatata opercularis Ratpathe velu! Rob. p. 332 and V. II p. 48. Grows In swamps near Pensacola; leaves smelling like honey, and decoying insects, who seeking for the honey, are entrapped within the leaves, and prevented to come out by the rigid thick hairs. Robin took the leaves for a flower or spatha."

Rafinesque's third and last entry on this species occurs on page 148 under "additions." Here an obvious typographical error changes the spelling of the name, but Rafinesque's correct analysis of the affinity of *S. leucophylla* and the aroids is made certain. The complete entry is:

> "1. Sp. 17. *Sarracenia lencophylla.* The genus *Sarracenia* has not the least affinity with the order or tribe of Aroides, it is because Robin mistook the singular leaves of this plant, for the spatha of an *Arum*, that he has united it thereto."

A comparison of Rafinesque's entry number 17, the first quoted above, with other entries in "Florula Ludoviciana" (e.g., 26, 39, 56, etc.) shows that there is a difference in form in entry 17 because of a rather serious typographical error. This error results in the heretofore unexplained phrase "Ratpathe velu". This part of entry 17 should read ". . . dilatata opercularis. Raf.—Spathe velu! Rob. p. 332 and V. II. p. 48." What appears to be a previous and peculiar name is thus in part actually only a short but garbled quotation from Robin—who had little or no tendency to give names to the new plants he saw on his travels in Louisiana and Florida.

With the determination of the validity and correct application of the name *Sarracenia leucophylla* Raf. there should be no further reason for not accepting the name under our present rules. To say that the name should not be accepted because Rafinesque was eccentric is to say that only people *we* think are competent botanists should name plants—an observation that, oddly enough, was also made by Rafinesque (1836). Such a point, desirable as it might be in certain cases, could never be legislated or enforced; it would be much more readily accepted and much more easily taught by example. Other arguments, both for and against the acceptance of valid Rafinesquian names, are well presented by Merrill (1949) and will not be repeated here. If proposals recently made by Rickett (1953) are adopted, it would be possible to maintain the more widely used name *S. Drummondii* Croom, which is referable to a type specimen, over

the earlier *S. leucophylla* Raf. which has no type specimen. Although such conservation of specific names might be advantageous in some cases, it might well prove more of a liability than an asset once the rules (if accepted) came to be interpreted by those who are literally out "to make a name for themselves".

In addition to the treatment of the name *Sarracenia leucophylla* Raf., given above, three other specific names proposed by Rafinesque for plants in this genus are disposed of below. This short list also includes one of Bartram's previously unlisted names and the four names together may be considered as a brief supplement to the list of names treated previously (Bell, 1952). Rafinesque's *Sarazina*, *Sarazinia* and *Sarrazinia* are all invalid variations of the spelling, and synonyms of, *Sarracenia* L.

Sarazina acuta Raf. Aut. Bot. p. 33. 1840. = Hybrid? (*S. purpurea* × —?)
Sarracenia galeata Bartram. Travels. 1791. Nomen nudum (= ? *S. minor* Walt.)
Sarazina heterophyla Raf. Aut. Bot. p. 33. 1840. = *S. heterophylla* Eaton.
Sarazina parviflora Raf. Aut. Bot. p. 33. 1840. = *S. purpurea* L.

According to the findings of Merrill (1948) the *Sarracenia alata* (Wood) Wood, published in 1863, has many years' priority over *S. Sledgei* Macfarlane, which was published in 1908. Therefore, *S. alata*, previously overlooked and still unindexed, is the valid name for plants formerly designated as *S. Sledgei;* and the name *S. Sledgei* is reduced to synonymy.

SUMMARY

The name *Sarracenia leucophylla* Raf. has not been accepted previously because of its uncertain status and application; and, unfortunately, because of some prejudice against Rafinesque. Since personal like or dislike is not a factor in the validity of a name and since the status and application of the name have now been elucidated, Rafinesque's name stands as valid, under our present rules, over the later synonym *S. Drummondii* Croom.

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THE CHARACEAE OF LAKE MATTAMUSKEET, NORTH CAROLINA[1]

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PLATES 7–9

INTRODUCTION

The existence of a remarkable expanse of muskgrass in Lake Mattamuskeet, Hyde County, North Carolina, was brought to the writer's attention by W. P. Baldwin of the Fish and Wildlife Service, United States Department of the Interior. In August, 1953, the writer had the opportunity to visit the region, and through the courtesy of Mr. W. G. Cahoon, Manager of Mattamuskeet National Wildlife Refuge, facilities were made available for a survey of the beds of Charas. The unique situation and the rapid changes in the flora of this lake merit a report at this time, and it is hoped that the taxonomic presentation will aid workers who are able to make future observations in these environs.

Lake Mattamuskeet is a 30,000-acre body of water located inland from Cape Hatteras and seven miles north of Pamlico Sound. Its extremely flat basin slopes to a maximum depth of three feet, and although the lake is fifteen miles long and seven miles wide one can wade over the entire area. The unusual history of the basin, its having been drained in 1915, cultivated, and finally allowed to refill in 1932, has been reviewed by Cahoon (1953). At the present time, it is being managed to promote duckfood plants. It is drained through six water control structures via canals into the Sound, and the water level is maintained in such a way as to keep the water fresh at a salinity of approximately 0.9 parts per thousand (2.5–2.7 per cent of sea water).

The Fish and Wildlife Service has maintained records of the changes in the lake, and extensive studies of the plant life (e.g. the unpublished reports of Rudolph and Baldwin, 1948; Rudolph, 1952; and Lapham and Vansandt, 1952) are available at the refuge's headquarters. These records indicate that the lake remained

[1] The third of a series of articles designed to expand the knowledge of variations within species complexes by providing critical analyses and figures of individual specimens rather than generalized concepts. The first is Wood's (1949) study at Cape Cod, and the second is the report by Wood and Muenscher (in press) for New York.

[2] Supported in part by the Research Fund of the College of Arts and Sciences of the University of Rhode Island.

turbid (Secchi disc reading, 6 inches) until 1949, after which the water began to clear gradually. The vegetation which rapidly invaded from the shore consisted entirely of Characeae, and the first growths were noted in 1949. By 1951 they had spread around the entire margin of the lake and had covered an area of 7500 acres. This area increased to 15,000 acres in 1952 and 17,000 acres in 1953. As far as is known to the writer this may be a record expanse of Characeae. As Baldwin pointed out to the writer, the value of this stand of muskgrasses to ducks can be imagined when one considers that the 1953–1954 winter population of birds was the greatest in the history of the refuge, a condition not reflected on most adjacent refuge areas.

The vegetation is in a highly mobile state, the Characeae which so rapidly invaded the lake being followed by a zone of various aquatic phanerogams including species of *Najas*, *Potamogeton*, and *Eleocharis*. Future observations of the changes in the vegetation of this area will be instructive.

THE CHARACEAE OF LAKE MATTAMUSKEET

Specimens of Characeae from the lake which were collected by Rudolph in 1949, by Baldwin in 1951 and 1952, and by the writer in 1953, are extant in the author's personal herbarium. A study of this material has been made and the results assembled into the following taxonomic treatment. One specimen was used for the description, and where the material was suitable all illustrations were also made from it. Finer details were drawn with the aid of a camera lucida, while larger portions were sketched as seen under a 30× stereoscopic microscope. Variations observed among other specimens are briefly discussed. The specimens which were studied are listed. The key is restrictive and is designed for use at this lake only. For explanations of technical terms, descriptions of the family and genera, and a synopsis of the tribes and genera, the reader is referred to Wood (1949).

The Characeae, commonly known as muskgrasses or stoneworts, constitute a large family of submerged aquatic cryptogamous plants about eighty species of which are known for North America. They are common throughout the world and are valued as waterfowl food plants, but may become so abundant as to interfere with boating and fishing. For a brief discussion of other academic and economic aspects of this group, see Wood (1952).

1a. Branchlets forked or subdivided. In the field the plants appear distinctly translucent and are soft to the touch.....Genus NITELLA

2a. Branchlets once-divided; compact heads occurring among the branchlets
1. *Nitella acuminata*

2b. Branchlets 2–5-times divided; without compact heads among the branchlets....3

3a. Delicate plants with whorls of branchlets ¼–¾ inch in diameter.....4

4a. Each branchlet whorl subtended by a similar but smaller whorl of accessory branchlets.....3. *Nitella hyalina*

4b. Branchlet whorls without smaller whorl of accessory branchlets
2. *Nitella tenuissima*

3b. Robust plants 1–2 ft. in height with branchlet whorls 1–2-more inches in diameter; dactyls generally terminated by 2-more-celled mucro
4. *Nitella microcarpa*

1b. Branchlets not forked or subdivided although bract cells occur along the branchlets. In the field the plants appear dense and not distinctly translucent and are harsh to the touch.....Genus CHARA

5a. Branchlets largely corticated throughout, and the axes with only obscure spines. Appearing smooth in the field
5a. *Chara zeylanica* var. *zeylanica*

5b. Branchlets largely uncorticated, and the axes spinescent. Appearing spiny in the field.....5b. *Chara zeylanica* var. *inconstans*

1. NITELLA ACUMINATA A. Br. ex Wallm.

Nitella acuminata [nom. nud.] var. *Belangeri* [as "Bellangeri"] A. Braun (1849: 292) (invalid); *Nitella acuminata* A. Braun cited by Wallman (1853: 263) (descr.).

The species is represented in our area only by the one variety.

a. var. BELANGERI A. Br. ex Wallm. (Pl. 7, Fig. 1; Pl. 8, Fig. 1, 5, 9, 18)

Nitella acuminata var. *Belangeri* A. Braun (1849: 292) (invalid); *Nitella acuminata* var. *Belangeri* [as "Bellangeri"] A. Braun cited by Wallman (1853: 263) [orth. mut. by Zaneveld (1940: 59)]; *Nitella Lindheimeri* A. Braun (1858: 355) (= var. *Belangeri*, fide Zaneveld (1940: 59)); *Nitella acuminata* var. *Lindheimeri* (A. Br.) A. Braun (1882: 38).

Delicate plants with long axial internodes, and isolated loose whorls of sterile branchlets in the axils of which occur numerous compact fertile heads 2–5 mm. in diameter. *Plants* monoecious, 10–16 cm. in height. *Axes* about 430 μ in diameter, the internodes up to 2 cm. long. *Sterile branchlets* 5 in a whorl, each 2–3 cm. long, 1-furcate. *Dactyls of sterile branchlets* 2, 5–10 mm. long, but commonly lost on older whorls, tapering to a sharp point. *Fertile branchlets* generally 6 in a whorl, each 1–2 mm. long, 1-furcate; several fertile whorls borne on a reduced branch compacted into tiny fertile heads which occur in the axils of the sterile branchlet whorls. *Dactyls of fertile branchlets* 3–4, somewhat longer than the primary ray, gradually tapering to a sharp point. *Oogonia* occurring laterally at the furcation of fertile branchlets, 472 μ long and 429 μ wide; convolutions 8; coronula 10-celled, 34 μ high and 39 μ wide, the cells of the upper tier about twice as long as those of the lower tier, persistent. *Oospore*

(Plate 7: Drawn from herbarium specimens extant in the writer's herbarium. Plates 8, 9: Microscopic details drawn with the aid of a camera lucida. For larger portions necessarily drawn freehand as seen under a 30× stereoscopic microscope an approximation of the magnification is indicated by "ca.")

PLATE 7

FIG. 1. *Nitella acuminata* var. *Belangeri*. × 0.5.
FIG. 2. *Nitella tenuissima*. A small specimen. × 0.5.
FIG. 3. *Nitella hyalina*. × 0.5.
FIG. 4. *Nitella microcarpa*. × 0.5.
FIG. 5. *Chara zeylanica* var. *inconstans*. × 0.5.
FIG. 6. *Chara zeylanica* var. *inconstans*. Short-branchlet form described as *Chara depauperata* by T. F. Allen and assigned to *Chara foliolosa* (= *Chara zeylanica* var. *zeylanica*) by C. B. Robinson. × 0.5.
FIG. 7. *Chara zeylanica* var. *zeylanica*. × 0.5.

PLATE 7

brown, 329 μ long and 322 μ wide; striae of 6–7 low ridges; membrane minutely roughened. Antheridia 250–286 μ in diameter. (Descr. from *W. P. Baldwin 23*.)

The specimens varied from 5 to 16 cm. in height, and the appearance deviated from the described material in forms having more robust dactyls and larger heads, e. g. *R. D. Wood & Leroy Hovell 538196*.

This species has been reported as rare each year since 1949.

Specimens seen: *R. R. Rudolph 9*, Sept. 14, 1949; *W. P. Baldwin 23*, Sept. 25, 1951; *R. D. Wood & Leroy Hovell 538196*, Aug. 19, 1953.

2. NITELLA TENUISSIMA (Desv.) Kütz. (Pl. 7, Fig. 2; Pl. 8, Fig. 2)

Chara tenuissima Desvaux (1809: 313) (descr.); *Nitella tenuissima* Kützing (1843: 319); *Nitella tenuissima* f. *longifolia* T. F. Allen (1880: 13) (descr.); *Nitella transilis* T. F. Allen (1896: 24) (= *Nitella tenuissima*, fide Wood and Muenscher (in press)).

Delicate plants with moderately long axial internodes and regularly-spaced whorls of small branchlets. *Plants* 5–7.5 cm. in height, monoecious. *Axes* 143–157 μ in diameter, internodes about 1 cm. long. *Sterile branchlets* (same as fertile). *Fertile branchlets* 6 in a whorl, each 5–8 mm. long, 3–4-furcate into 5–6 secondary rays, 5 tertiary rays, 2–5 quaternary rays of which 2–3 are again divided into 3–4 quinary rays. *Dactyls of fertile branchlets* 3–4, 2-celled including the short, conical to somewhat elongated mucro which is 71 μ long and 21 μ wide at the base; dactyl tapering sharply toward the base of the mucro. *Oogonia* generally one at a node, occurring at the 1st–3d furcations, 344 μ long and 265 μ wide (incl. coronula), forming late in the growing season; convolutions 7; coronula

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PLATE 8

FIG. 1. Oogonium of *Nitella acuminata*. × 79.
FIG. 2. Oogonium of *Nitella tenuissima*. × 79.
FIG. 3. Oogonium of *Nitella hyalina*, showing mucus envelope. × 79.
FIG. 4. Oogonium of *Nitella microcarpa*. × 79.
FIG. 5. Oospore of *Nitella acuminata*. × 79.
FIG. 6. Oogonium of *Chara zeylanica* var. *zeylanica*. × 79.
FIG. 7. Oospore of *Chara zeylanica* var. *zeylanica*. × 79.
FIG. 8. Oospore of *Chara zeylanica* var. *inconstans*. × 79.
FIG. 9. Coronula of *Nitella acuminata*. × 341.
FIG. 10. Coronula of *Nitella hyalina*. × 341.
FIG. 11. Coronula of *Nitella microcarpa*. × 341.
FIG. 12. Coronula of *Chara zeylanica* var. *inconstans*. × 79.
FIG. 13. Terminal portion of branchlet of *Chara zeylanica* var. *inconstans* showing radiate bract cells at the terminal and subterminal nodes and the terminal cluster formed from the end cell of the branchlet and the bract cells of the terminal branchlet node. ca. × 24.
FIG. 14. Apex of bract cell of *Chara zeylanica* var. *inconstans*. × 79.
FIG. 15. Apex of dactyl of *Nitella hyalina*. × 79.
FIG. 16. Sterile branchlet of *Nitella hyalina*. ca. × 25.
FIG. 17. Accessory branchlet of *Nitella hyalina*. ca. × 25.
FIG. 18. Dactyls of *Nitella acuminata*. × 79.
FIGS. 19–20. Apices of dactyls of *Nitella microcarpa* showing 1-celled mucro and a 4-celled mucro. × 79.

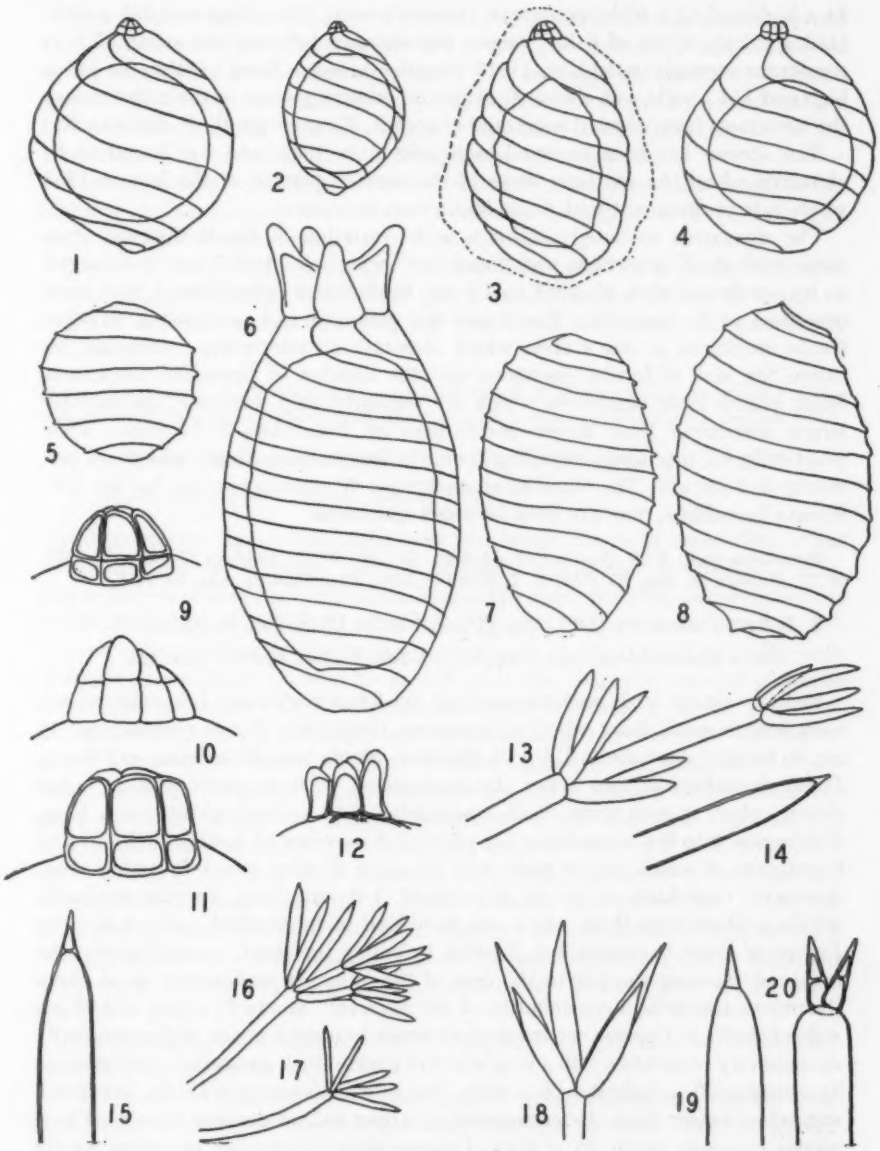

PLATE 8

34 μ high and 51 μ wide, persistent. *Oospore* brown, 229 μ long and 215 μ wide (142 μ thick); striae of 6 low ridges, the distance between the striae 37.4 μ; membrane strongly reticulate, 11–12 reticulae across a fossa. *Antheridia* 146 μ high and 164 μ wide, not obviously stipitate, occurring at all fertile nodes except the lowermost from which it is invariably absent. (Descr. from *W. P. Baldwin 27*.)

This species has been reported each year since 1949, and was found to be abundant along the southern shore of the western portion of the lake in 1953 where it is co-dominant with *C. zeylanica* var. *inconstans*.

The specimens collected exhibit a wide variation in fertile material from those with short branchlets and "bead-like" whorls 0.5 to 0.7 cm. in diameter to lax specimens with whorls 1 to 1.5 cm. in diameter (which forms have been described as *N. transilis*). The writer has collected and mounted a series of fertile specimens at one station which illustrate an interesting correlation between the size of fertile specimens and the number of branchlet furcations. Small plants have branchlets which are regularly only 2-furcate, increasingly larger specimens have larger percentages of branchlets 3–4-furcate, while practically all specimens exceeding 5 cm. in height have whorls which are primarily 3–4-furcate. The classical character for *N. tenuissima*, i.e. having 3–4-furcate branchlets, may not hold for small specimens!

Specimens seen: *R. R. Rudolph 11, 12*, Sept. 14, 1949; *W. P. Baldwin 27*, Sept. 25, 1951; *W. P. Baldwin 38*, Aug. 25, 1952; *R. D. Wood & Leroy Hovell 538194*, Aug. 19, 1953.

3. NITELLA HYALINA (DC.) Ag. (Pl. 7, Fig. 3; Pl. 8, Fig. 3, 10, 15, 16, 17)

Chara hyalina DeCandolle (1805: 247); *Nitella hyalina* Agardh (1824: 126).

Delicate plants with moderate to long axial internodes and branchlet whorls each with a small inner whorl of accessory branchlets. *Plants* monoecious, 14 cm. in height. *Axes* about 314 μ in diameter. *Sterile branchlets* (same as fertile). *Fertile branchlets* of two types (heteroclemous) with an outer and an inner (lower) whorl at each node. Main branchlets 6–8 in a whorl, about 6 mm. long, 2–3-furcate into 6–7 secondaries (of which 2–3 may not be further divided) and 6 tertiaries of which one or more may be again divided into 4–6 quaternaries. Accessory branchlets about 14 in a whorl, 1–3 mm. long, varying markedly within a whorl from those which are undivided to those which are 1–2-furcate. *Dactyls of fertile branchlets* 3–6, 2-celled including the short, conical mucro; the main cell tapering sharply to the base of the mucro in such a way as to make the mucro appear as a continuation of the main cell; mucro 71 μ long and 28.5 μ wide at the base. *Oogonia* occurring at all fertile branchlet nodes, and occasionally on accessory branchlets, 538 μ long and 343 μ wide (incl. coronula); convolutions 8; coronula 20 μ high and 60 μ wide, the cells convergent with the lower cell somewhat longer than the corresponding upper cell; oogonium enveloped in a mucus envelope about 30 μ thick. *Oospore* dark brown and becoming nearly opaque when mature, 336 μ long and 307 μ wide; striae of 6–7 low ridges, the distance between striae 45.7 μ; membrane minutely granular (pitted?), 5–6 granulae per micron. *Antheridia* 322 μ long and 357 μ wide, occurring at all furcations of fertile branchlets. (Descr. from *R. D. Wood & Leroy Hovell 538193*.)

This species was reported for the first time in 1953. It was so widespread this year that it seems improbable that it could have invaded and become so firmly established in one growing season. The very marked similarity between this and *N. tenuissima* in the field may well account for earlier collectors' failures to obtain specimens of both types. It was abundant in the southeast end of the lake where it is co-dominant with *C. zeylanica* var. *zeylanica*.

The specimens exhibit little basic variation aside from the irregularities inherent in the accessory branchlets. The size varied from 5 to 18 cm. in height, while the whorls ranged from 0.6 to 1 cm. in diameter.

Stewart's (1937: 174) statement that the branchlets are typically 3-divided is somewhat misleading even for his own descriptions and figures. It would be closer to the facts to say that they are typically 2–3-divided, and occasionally 4-divided.

Specimens seen: *R. D. Wood & Leroy Hovell 538193*, Aug. 19, 1953; *R. D. Wood & Leroy Hovell 538193a* is a sheet consisting of selected small forms from the main collection.

4. NITELLA MICROCARPA A. Br. (Pl. 7, Fig. 4; Pl. 8, Fig. 4, 11, 19, 20)

Nitella microcarpa A. Braun (1858: 357) (descr.).

Rather robust plants with stout axes and broad whorls of branchlets. *Plant* monoecious, 12 cm. in height. *Axes* about 1085 μ in diameter, internodes 3–5 cm. long in the lower portions and 1–2 cm. long in the upper portions. *Sterile branchlets* 6–7 in a whorl, 2–3 cm. long, 1–2-furcate. *Dactyls of sterile branchlets* 2–5, 2–5 (–more)-celled, including the normal ray and one or two conical end cells, each of which is commonly divided by a cross wall into two cells; dactyls of sterile branchlets largely lost on this specimen. *Fertile branchlets* 6–7, 2–3 cm. long, similar to the sterile branchlets in general size and appearance, but 3–4-furcate into 4–5 secondaries two of which are divided again into 2–4 tertiaries of which one or more are divided into 3 quaternaries. *Dactyls of fertile branchlets* resemble those of sterile branchlets, but are persistent in this specimen. *Oogonia* 2–3 (1–4) at all fertile branchlet furcations, 475 μ long and 372 μ wide (incl. coronula); convolutions 8; coronula 51 μ high and 72 μ wide, the upper cells somewhat longer than the lower cells; without mucus. *Oospore* light brown, 301 μ long and 286 μ wide; striae of 6–7 low ridges, the distance between striae 59 μ; membrane strongly reticulate, 13–15 reticulae across a fossa. *Antheridia* 250 μ high and 357 μ wide, with 8 irregularly-placed shield plates. (Descr. from *W. P. Baldwin 26*.)

This species was uncommon in 1949–1952, and was not noticed in the 1953 inspection by the writer.

The size of the oospores places this specimen intermediate between the published (Zaneveld, 1940: 102) limits of var. *Glaziovii* (oospores 240–280 μ) and var. *microglochin* (oospores 180–240 μ) on the one hand, and var (ssp. or sp?) *megacarpa* (oospores 370–450 μ) on the other. Such intermediates as this aid in confirming the infraspecific status of *N. megacarpa* T. F. Allen within *N. microcarpa*.

The material is identical in all critical respects to Tuttle's "new sp. and gen."

(1926) which was collected at Charlottesville (vidi in herb. William Randolph Taylor) and used in his attempt to locate meiosis at gametogenesis.

Specimens seen: *R. R. Rudolph 10*, Sept. 14, 1949; *W. P. Baldwin 26*, Sept. 25, 1951.

5. CHARA ZEYLANICA Klein in Willd.

Chara zeylanica Klein (ined.) in Willdenow (1805: 184) (descr.); *Chara foliolosa* Muhlenberg (ined.) in Willdenow (1805: 185).—Priority for name established by Persoon (1807: 530) and followed by Henry and James Groves (1911: 40).

The species is represented here by two varieties which are strikingly different in appearance and in certain details. They have been considered to be distinct species (Robinson, 1906), varieties (Groves, H. and J., 1911), or merely forms (Zaneveld, 1940).

a. var. ZEYLANICA (the type form). (Pl. 7, Fig. 7; Pl. 8, Fig. 6, 7; Pl. 9, Fig. 4)

Chara zeylanica f. *typica* Zaneveld (1940: 207) (illeg.); *Chara foliolosa* Muhl. in Willd., sensu Robinson (1906: 290).

Rather trim-looking plants, harsh to the feel, smooth in appearance and with branchlets no more translucent than the axes, and with a strongly fetid odor. Individual shoots attached by interconnecting rhizoids. *Plants* monoecious, 30 cm. in height. *Axes* about 430 μ in diameter, completely corticated, the cortication regularly triplostichous and very slightly dextrorotary, primary and secondary cells nearly equal in diameter or somewhat tylacanthous. *Spine cells* solitary, obscure to the naked eye, generally scattered although occasionally occurring in cross bands, varying in length from $\frac{1}{3}$ as long as to just exceeding in length the diameter of the axis (107–645 μ long and 43 μ wide). *Stipulodes* in two tiers, twice the number of branchlets in each tier (about 20), those of the upper tier somewhat longer or shorter than the naked basal branchlet internodal cell but not obscuring these cells; lower stipulodes about $\frac{3}{4}$ as long as the upper.

PLATE 9

FIG. 1. *Chara zeylanica* var. *inconstans* showing two tiers of stipulodes at the axial node, the naked branchlet segments, and abaxial bract cells at the 1st branchlet node. ca. × 47.

FIG. 2. *Chara zeylanica* var. *inconstans* showing the irregularities in cortical pattern and somewhat tylacanthous condition of a mature axial internode. ca. × 65.

FIG. 3. *Chara zeylanica* var. *inconstans* showing adaxial view of a fertile branchlet node. ca. × 60.

FIG. 4. *Chara zeylanica* var. *zeylanica* showing axial node, two tiers of stipulodes, the scattered arrangement of the short spine cells, the naked basal branchlet internodal cells, corticated branchlet segments, and the bract cells at the 1st and 2nd branchlet nodes. ca. × 32.

FIG. 5. *Chara zeylanica* var. *inconstans*. Axial node and whorl of branchlets of the short-branchlet form described by T. F. Allen as *Chara depauperata* and assigned to *Chara foliolosa* by C. B. Robinson. Note the irregularity in the number of corticated branchlet segments, the small number of branchlet segments, the terminal cluster of bract cells and the branchlet end cell, and the irregularity in the lengths of the naked basal branchlet internodal cells. ca. × 28.

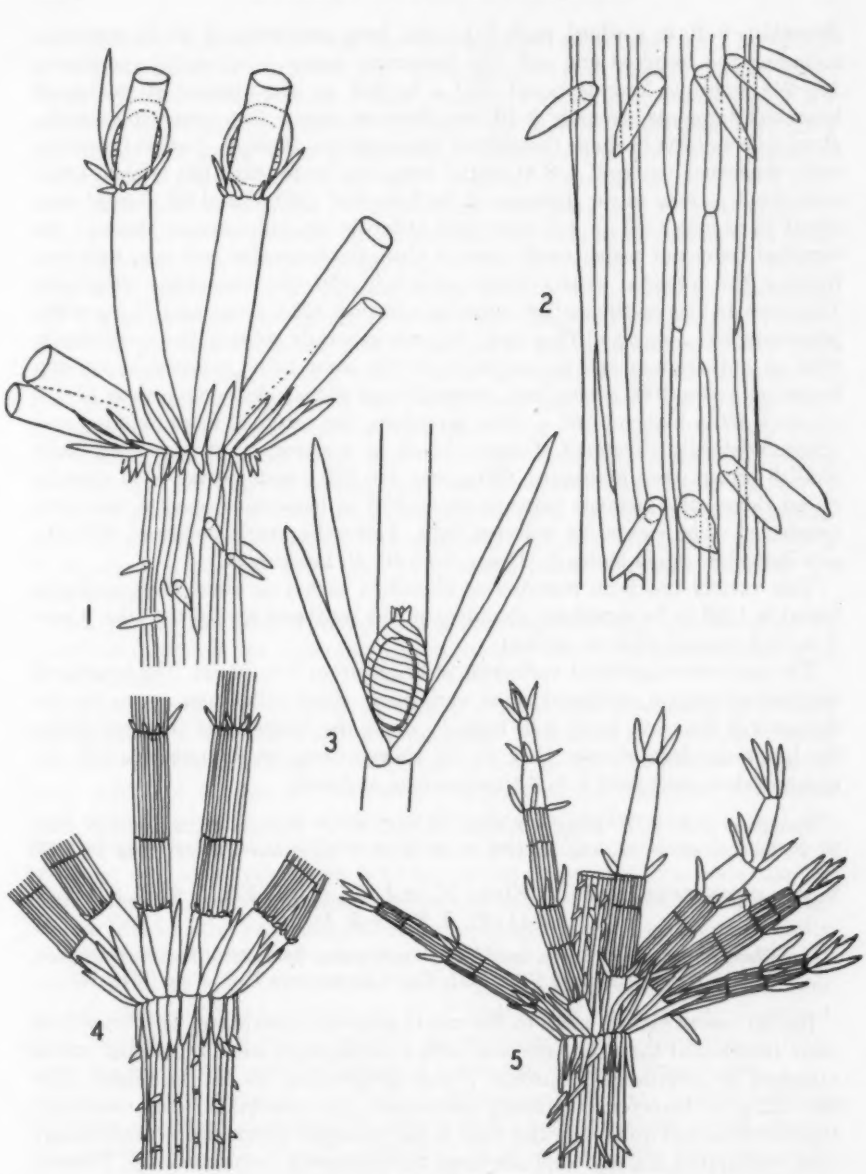

PLATE 9

Branchlets 9–10 in a whorl, each 1–1.5 cm. long, consisting of 10–12 segments including the terminal end cell; the lowermost segment invariably ecorticate, 1½–2½ times as long as broad (572 μ by 357 μ); the number of corticated branchlet segments generally 8–10, but there are only 5–6 in occasional whorls. *Bract cells* uniform in shape throughout the segments, those at the first branchlet node somewhat reduced; 6–8 at sterile branchlet nodes with the adaxial bract cells about as long as the diameter of the branchlet (485 μ) and the abaxial ones about ½ as long (216 μ); 4–5 bract cells at fertile branchlet nodes; those at the terminal branchlet nodes much shorter than the branchlet end cell, thus not forming the terminal cluster which occurs in the var. *inconstans*. *Bracteoles* 1½-times as long as the mature oogonia; anteriors 1275 μ long and 71.5 μ wide, posteriors 930 μ long and 78 μ wide. *Oogonia* generally solitary but occasionally with an antheridium and an oogonium at the same node, common at 1st–4th branchlet nodes, 1000 μ long (incl. coronula) and 566 μ wide; convolutions 12–15; coronula 150 μ high and 207 μ wide, persistent, the terminal lobes rounded and characteristically divergent. *Oospore* black at maturity, but appearing light reddish brown when immature; 680 μ long and 429 μ wide; striae of 11 slightly raised ridges, the distance between striae 59.5 μ; membrane opaque, minutely roughened when viewed by reflected light. *Antheridia* nearly spherical, 357–411 μ in diameter; shield plates 4. (Descr. from *W. P. Baldwin 22*.)

This variety has been reported as abundant each year since 1949, and was found in 1953 to be especially abundant in the southeast end of the lake where it is co-dominant with *N. hyalina*.

The specimens exhibited variations in height from 7 to 30 cm. The lengths of detailed structures exhibited some variations: spine cells from ¼ to ½ the diameter of the axes; bract cells from ½ to ⅔ the diameter of the branchlets; the bracteoles from shorter than to 1½ times as long as the oogonia; and the gymnopodous cells from 1 to 3 times as long as broad.

Specimens seen: *R. R. Rudolph 8*, Sept. 14, 1949; *W. P. Baldwin 22, 25*, Sept. 25, 1951; *W. P. Baldwin 39, 40, 42*, Aug. 25, 1952; *R. D. Wood & Leroy Hovell 538191*, Aug. 19, 1953.

b. var. INCONSTANS (A. Br. ex Kütz.) H. & J. Gr. (Pl. 7, Fig. 5, 6; Pl. 8, Fig. 8 12–14; Pl. 9, Fig. 1–3, 5)

Chara inconstans A. Braun (ined.) cited by Kützing (1857: 28); *Chara zeylanica* var. *inconstans* H. and J. Groves (1898: 323); *Chara depauperata* T. F. Allen (1894: 167).

Rather coarse plants, harsh to the touch, spiny in appearance, with branchlets more translucent than the axes, and with a strong fetid odor. Individual shoots attached by intertangled rhizoids. *Plants* monoecious, 29 cm. in height. *Axes* 351–422 μ in diameter, completely corticated, the cortication being essentially triplostichous but quite irregular even in the youngest internodes with secondary cells overlapping slightly (diplostichous) to completely (triplostichous). Primary cortical cells wider than secondaries (tylacanthous). *Spine cells* solitary, obvious to the naked eye, commonly occurring in cross bands, varying in length from shorter to longer than the diameter of the axis. *Stipulodes* in two tiers, twice

the number of branchlets in each tier (20–24), upper stipulodes (607 μ by 42.9 μ) 1–2-times as long as the lower, not obscuring the naked basal branchlet internodal cell. *Branchlets* 9–11 in a whorl, each 1–1.5 cm. long, consisting of 6–7 segments including the terminal end cell; the lowermost segment invariably ecorticate, 4–8 times as long as broad; the number of corticated segments varying among the whorls on the same rhizoidal clone and generally 0–1 (–4). *Bract cells* uniform in shape throughout the branchlets, but varying widely in size; at sterile nodes generally 5, radiate, varying from equal in length to those with abaxials ½ as long as the adaxials; at fertile branchlet nodes 4–5, shorter than those of sterile nodes; radiate at the terminal node, strongly resembling the end segment of the branchlet with which they form a terminal cluster. *Bracteoles* generally exceeding mature oogonia in length; anteriors 1284 μ long; posteriors 895 μ long. *Oogonia* conjoined, an antheridium and an oogonium at each fertile node, commonly at the 1st–3d branchlet nodes, 930 μ long (incl. coronula) and 522 μ wide; convolutions 13; coronula 93 μ high and 143 μ wide, the terminal lobes rounded and characteristically divergent, persistent. *Oospore* black at maturity, but appearing light reddish brown when immature, 680 μ long and 394 μ wide; striae of 11–12 slightly-raised ridges, the distance between striae 59 μ; membrane opaque, but apparently smooth. *Antheridia* 322–358 μ in diameter, somewhat wider than long; shield plates 4. (Descr. from *W. P. Baldwin 28.*)

This variety has been reported each year since 1949, and was found to be abundant in 1953 in the southwest end of the lake where it is co-dominant with *N. tenuissima.*

The variations within a given shoot are so great that evaluating differences among plants is difficult. The following ranges in lengths of certain structures were noted: spine cells from 1 to 2 times as long as the diameter of the axes; bract cells 2 to 4 times as long as the diameter of the branchlet; bracteoles from somewhat longer to somewhat shorter than the mature oogonia; and the gymnopodous cells 5 to 10 times as long as broad. The number of corticated branchlet segments varies from 0 to 5, and the bract cells at a node may be radiate and equal or the abaxial ones may be reduced. Despite the wide variations in this and the preceding variety, typical specimens of each can be easily recognized. The number of quantitative differences provides an imposing list which would aid one to consider the two as distinct species. Clear intermediates are, however, found as illustrated by *W. P. Baldwin 43* which has the shortened gymnopodous cells of var. *zeylanica.* As indicated in the discussion, further observations will help test the degree of distinction between these types.

A series of specimens (*R. D. Wood & Leroy Hovell 538191c*) is remarkable in exhibiting extremely shortened branchlets which give the plants a thin, wand-like appearance (Pl. 7, Fig. 6) resembling *C. filiformis* Hertz. However, aside from the shortened branchlets and the shortened gymnopodous cells (which even in this case range in size up to 5 times as long as broad) the specimens are typical of var. *inconstans.* They have few branchlet segments, 1–3 corticated segments, and the number of such segments varies within a whorl. These speci-

mens proved to be identical in all critical respects to *C. depauperata* when compared with the holotype.[3] Therefore, Allen's species, *C. depauperata*, is to be relegated to *C. zeylanica* under the variety *inconstans*, a decision different from that of Robinson (1906: 290) who assigned it to *C. foliolosa* (= var. *zeylanica*).

Specimens seen: *W. P. Baldwin 23b, 24, 28, 29, 30*, Sept. 25, 1951; *R. D. Wood & Leroy Hovell 538191a, b, c, 538193, 538195*, Aug. 19, 1953; *A. E. Radford 5400*, July 4, 1950.

DISCUSSION

An inspection of the records of species collected shows that the species of Characeae have changed little or not at all since invasion in 1949. Although *Chara zeylanica* var. *inconstans* was not reported until 1951 and *Nitella hyalina* not until 1953, they are both so similar to other species as to suggest that the absence of earlier records is due to the failure of collectors to detect them in the field. It follows that the present vegetation very probably is derived from species which originally appeared in 1949. The distribution of these species is interesting, with *N. hyalina* and *C. zeylanica* var. *zelyanica* dominant in the eastern portion of the lake and *N. tenuissima* and *C. zeylanica* var. *inconstans* dominant in the western portion of the lake. No significant ecological differences between these two portions of the basin have been detected (Tab. 1), and shifting winds tend to mix the water by driving it back and forth through the breaches in the central causeway. It appears that these combinations of species became established toward the two ends of the lake from ponds in the surrounding marsh by the flooding high water in 1949, and that the subsequent invasion of the lake has occurred from both directions. This unique situation would be ideal for testing the degree of distinctness between the two varieties of *C. zeylanica*, a test which has not been carried out under controlled laboratory or field conditions for these or for any Characeae so far as is known to the writer. Where the two varieties meet, as has already occurred in the eastern bay in 1953, they should be expected to blend through interfertilization if they are infraspecific taxa; but they should be expected to retain their individuality if they are distinct species. Future observations in this bay may be rewarded by decisive evidence, and already the finding of intermediate forms indicates the probable correctness of the infraspecific status.

The peculiar combination of factors which seems to have resulted in the tremendous expanse of Characeae at Lake Mattamuskeet includes (1) the clearing of the water in 1949, (2) the extreme drought and low water of 1948 followed by the flooding of the surrounding marsh and ponds containing thriving Characeae in 1949 (an occurrence which would disseminate the oospores into the lake proper), and (3) the favorable water level in 1950, 1951, and 1952. At the present time the invasion of Characeae is being followed by one of aquatic phanerogams along the shore. It will be interesting to watch the sequence of changes in future years to determine whether the Characeae will become estab-

[3] *Chara depauperata* T. F. Allen. *J. I. & Alice R. Northrop 258*, 1890. Near Nassau, N. P. Bahamas, W. I. (NY). HOLOTYPE.

TABLE 1

Water quality of Lake Mattamuskeet, N. C., as measured by pH, methyl orange alkalinity (M. O.), *salinity* (S), *and Secchi disc readings at three stations* (*N = North Bridge, M = Middle Bridge, S = South Bridge of the dividing causeway*) *on four dates. Data from W. P. Baldwin in letter to the author, Nov. 27, 1953.*

DATE	pH			M. O.			*S* % of sea water			SECCHI DISC (INCHES)		
	N	*M*	*S*	*N*	*M*	*S*	*N*	*M*	*S*	*N*	*M*	*S*
9/ 8/48	7.1	7.1	7.3	40	36	38	3.0	2.5	2.8	10	6	6
8/12/50	7.2	7.3	7.3	30	30	38	2.3	2.5	2.2	11	11	13
10/27/51	7.8	—	—	35	—	—	2.6	—	—	—	—	—
10/26/53	7.2	7.6	7.7	32	35	35	2.5	2.6	2.7	—	—	—

lished in the wave-swept central area of the lake, and the rate at which the aquatic phanerogams replace them.

SUMMARY

1. The existence of a tremendous expanse of Characeae at Lake Mattamuskeet, North Carolina, stimulated a study of the specimens collected and of the changes in the flora and vegetation between 1949 and 1953.

2. The represented species of Characeae are described and illustrated, and an analytical key is included. The forms found include *Nitella acuminata* var. *Belangeri*, *N. tenuissima*, *N. hyalina*, *N. microcarpa*, and *Chara zeylanica* var. *zeylanica* and var. *inconstans*.

3. *Chara depauperata* is found to be *C. zeylanica* var. *inconstans*; Tuttle's "new sp. and gen." is found to be *Nitella microcarpa*; and *N. tenuissima* is found to vary from 2-furcate in small specimens to 3–4-furcate in large specimens, and to embrace *N. transilis*.

4. Proper management for waterfowl food plants, coupled with ideal climatic conditions, resulted in clearing of the turbid water in this barren lake, and a rapid invasion by Characeae began in 1949.

5. The area covered by Characeae increased rapidly to 7500 acres in 1951, 15,000 acres in 1952, and 17,000 acres in 1953, an expanse which may well be a record.

6. The existence of different combinations of species in the two basins of the lake indicates invasion from the two ends with subsequent encroachment on the center. This is an ideal situation for testing the specific versus infraspecific status of *Chara inconstans* and *C. zeylanica* by noting whether blending occurs by fertilization where they meet. Intermediate specimens already found suggest the two to be conspecific, and the two are treated in this report as varieties.

7. The importance of these plants as duckfood is indicated by a record bird population at this lake in 1953, an occurrence not reflected at most adjacent refuge areas.

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THE GENUS SCIRPUS IN NORTH CAROLINA*

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INTRODUCTION

The last comprehensive treatment of the genus *Scirpus* for North Carolina appeared in the annotated list of *Indigenous and Naturalized Plants of North Carolina* by M. A. Curtis (1867). In this catalogue Curtis listed nine species as occurring in the state. A more recent treatment of the North Carolina species of *Scirpus* appeared in *A Guide to the Spring and Early Summer Flora of the Piedmont, North Carolina* by Blomquist and Oosting (1953). As is evident from the title this is restricted in range and season and is not inclusive for the state, only nine species being considered. Otherwise, the genus in the state has been treated only in works of a floristic or monographic nature covering broad geographical areas, as Torrey (1836), Chapman (1883), Small (1933), Beetle (1947), Fernald (1950) and Gleason (1952).

In view of these records, this study has been undertaken to determine which of the entities in the genus *Scirpus* are present and the county-by-county distribution of each within the state. Habitat correlations are also considered, particularly in relation to salt tolerance of estuarine species. A key to the taxa found to occur in the area is also presented.

HISTORICAL NOTES ON THE GENUS SCIRPUS

Robert Brown, in 1810, described a new genus, *Isolepis*, in the tribe Scirpeae, under which he indiscriminately categorized all those cyperaceous plants having achenes lacking in perianth bristles. This genus was readily accepted by the taxonomists of the period and for nearly 100 years a great many recombinations in the tribe Scirpeae were made. By far the greatest majority of these transfers involved members of the genus *Scirpus*. However, Boeckler (1869–70) called attention to the artificiality of the genus *Isolepis* which was based solely on the often variable character of the presence or absence of perianth bristles. Fernald (1901) likewise pointed out the inconsistency of this character and, thereafter, the genus was completely discarded. Beetle (1945) published an historical synopsis of the genus *Isolepis*. In this he clarified much of the nineteenth century botanical literature pertaining to the numerous genera in the tribe Scirpeae (*Scirpus* included) formerly regarded as *Isolepis*.

Perhaps the most prolific writers on *Scirpus* have been A. A. Beetle and M. L. Fernald. Beetle (1940–1953) has studied extensively in the genus and Fernald worked for nearly fifty years on the North American Cyperaceae. Gilly (1946) made a study of the Cyperaceae of Iowa, and Thornton (1934) treated the Indiana species of *Scirpus*.

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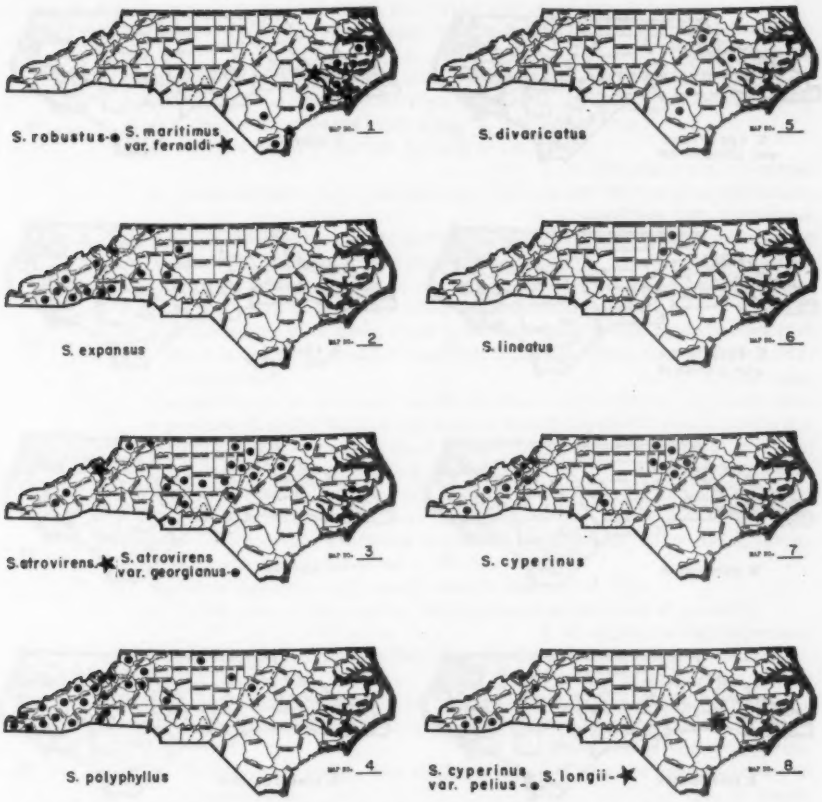
The two subgenera EUSCIRPUS and APHYLLOIDES as defined by Beetle (1940) are employed in the systematic treatment below. These seem to be natural subdivisions of the group. The evidence of Monoyer (1934) indicates that EUSCIRPUS is more primitive than APHYLLOIDES. He reports that in the phylogenetical history of the genus the trend has been toward reduction in the number of leaves, loss of the involucral bracts, and reduction in the number of spikelets. For the most part, the arrangement of the taxa is presented below as in Beetle's treatment of *Scirpus* in the North American Flora (1947).

A large genus in the Cyperaceae, *Scirpus* (the Latin name for bulrush) is generally regarded as containing over 250 distinct species. It is nearly world-wide in distribution and, being a diverse and often variable group, many problems have been encountered in attempting to come to a clearer understanding of the interrelationships within some of the sections of the genus. Section BOLBOSCHOENUS, which includes *Scirpus maritimus* and its allies, is an example of such a group. Here, many confused identities exist as a result of a high degree of variability, poorly defined taxa, and consequent nomenclatural fluctuation. A similar situation is found in the *Scirpus cyperinus* complex of the section TRICHOPHORUM. Within a population of this complex, intergrading of characters is rather common.

SYSTEMATIC TREATMENT

This study is based principally on material obtained from the larger herbaria of the eastern United States together with the author's own collections. In all, the author has examined over 900 specimens of *Scirpus*. In addition, use has been made of the various manuals and papers which are listed in the bibliography. In order to conserve space, specimens are not cited in this paper except where certain notable records appear. The abbreviations used to indicate the herbaria where these notable records are on deposit are: (NCS) North Carolina State College Herbarium; (UNC) University of North Carolina Herbarium; (G) Gray Herbarium, Harvard University; (US) United States National Herbarium, Smithsonian Institute. A complete listing of North Carolina specimens of *Scirpus* examined by the author is on file at the North Carolina State College Herbarium. The county-by-county distribution of representatives of the genus in the state is indicated in this paper by maps 1–16.

This study has revealed the presence of 20 taxa in the genus *Scirpus* in North Carolina. Three of them are being reported here as new records for the state. These are: *Scirpus maritimus* var. *fernaldii*, *S. cyperinus* var. *pelius*, and *S. subterminalis*. It is possible that another taxon, *Scirpus fontinalis*, may be present in North Carolina, as this is known from southeastern Virginia and South Carolina. For this reason *S. fontinalis* is included in the key to the North Carolina species of *Scirpus* presented here. The various members of the genus are widespread throughout the state, occurring from the highest mountain peaks in western North Carolina to the coastal estuaries in the east. Some of the taxa occur throughout the three physiographic provinces, the mountains, piedmont, and coastal plain; others in but one or only two of these regions. However, the present distribution records for North Carolina are such as to indicate that



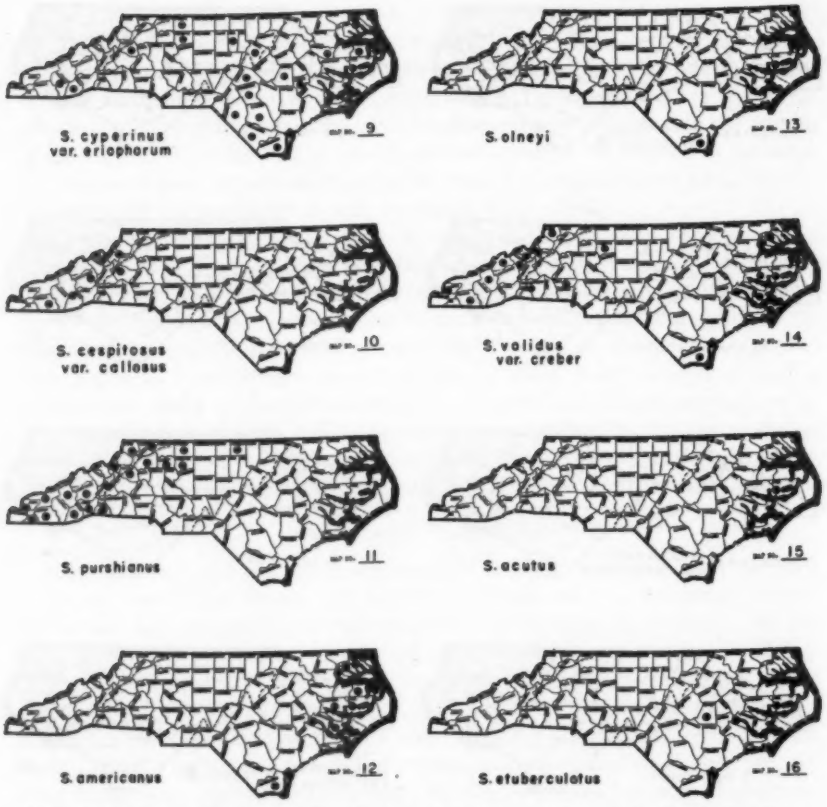
MAPS 1–8. County by county distribution of the taxa of *Scirpus* in North Carolina

an extended range for several entities may be expected after more intensive exploration.

Generic Description

SCIRPUS L. Sp. Pl. 47, 1753; Gen. Pl. ed. 5: 26, 1754.

Mostly stoloniferous or cespitose perennials, sometimes cespitose annuals; culms triangular, subterete or terete, sheathed at base, leafy or with blade reduced to a mucro; spikelets few-to-many-flowered, ovoid to near cylindric, sessile or peduncled, solitary or in capitate, spicate or umbelliform clusters; clusters often subtended by secondary bracts (involucels); inflorescence terminal, or sometimes appearing lateral, subtended by one to many involucral bracts (if one, usually appearing as a continuation of the culm, if more than one, leaf-like); scales spirally imbricated, subtending perfect flowers or the lower ones sometimes empty; perianth of 1–6 (–8, or none) hypogynous bristles, weakly or



MAPS 9–16. County by county distribution of the taxa of *Scirpus* in North Carolina

strongly developed, shorter than to exceeding the achene, barbed or smooth; stamens 2–3; style 2–3 cleft, deciduous, usually leaving an apiculate tip on the trigonous or lenticular achene; achene up to 4 mm. long.

Type species: *Scirpus sylvaticus* L.

Key to Scirpus in North Carolina

a- Plants with inflorescence subtended by a series of foliaceous involucral bracts
Subgenus EUSCIRPUS

b- Culms sharply triangular, spikelets 1.2–4 cm. long, achenes more than 1.5 mm. long.

c- Spikelets castaneous to drab, not rufescent, glomerate, mostly 3–5 in pedicellate glomerules; spikelets nearly cylindric, gradually tapering to an acute or subacute apex.....1. *S. maritimus* var. *fernaldii*.

c- Spikelets tawny or rufescent, sessile in glomerate head or with an occasional spikelet pedicelled; spikelets ovoid to thick cylindric, blunt or rounded at the apex.....2. *S. robustus*.

b- Culms obtusely triangular, spikelets 0.2–1.5 cm. long; achenes smaller, 1.5 mm. long or less.

d- Bristles mostly straight, barbed, or bristles absent; plants stoloniferous.
e- Sheaths, at least the lower, tinged with red; bristles coarsely barbed to base
3. *S. expansus*.
e- Sheaths green, not tinged with red; bristles barbed only above the middle.
f-Bristles equalling or shorter than the achene, or absent; spikelets brownish; cauline leaves fewer than 19, internodes long.
g- Bristles coarsely barbed, as long as the achene
4. *S. atrovirens* var. *atrovirens*.
g- Bristles absent, or if present, very delicate and shorter than the achene
5. *S. atrovirens* var. *georgianus*.
f- Bristles twice as long as the achene; spikelets reddish; cauline leaves more than 10, appearing distichous; internodes short.....6. *S. polyphyllus*.
d- Bristles strongly curled, smooth to slightly pubescent; plants non-stoloniferous.
h- Bristles not conspicuously exceeding the scales at maturity.
i- Cauline leaves 10 or more, those toward the base becoming distichous with short internodes; scales cowled, not flattened, blunt tipped, with a wide green midrib.....7. *S. divaricatus*
i- Cauline leaves 10 or fewer, the lower ones not distichous, the internodes prolonged; scales flattish, the slender midrib excurrent as a subulate tip.
j- Curled bristles usually much longer than the rugose achene; prinicpal cauline leaves mostly 3–8 mm. wide.....8. *S. lineatus*.
j- Curled bristles only rarely exceeding the smooth achene; principal cauline leaves mostly 8–15 mm. wide.....8a. *S. fontinalis*.
h- Bristles conspicuously exceeding the scales at maturity, often giving the inflorescence a woolly appearance.
k- Spikelets mostly in tight glomerules at the ends of rays.
l- Involucels reddish-brown, the bristles reddish-brown at maturity
9. *S. cyperinus* var. *cyperinus*.
l- Involucels blackish, the bristles whitish to pale brownish at maturity
10. *S. cyperinus* var. *pelius*.
k- Spikelets mostly pedicellate, or at least the lateral ones of each group.
m- Involucels and wool brown to reddish, the achenes whitish
11. *S. cyperinus* var. *eriophorum*.
m- Involucels blackish, the wool whitish, the achenes reddish-brown to castaneous.....12. *S. longii*.
a- Plants with inflorescence not substended by foliaceous bracts but by a single bract (which appears as an extension of the culm), or by the lowest scale of the spikelet
Subgenus APHYLLOIDES
n- Involucral bract represented by a single deciduous scale which subtends a solitary spikelet.....13. *S. cespitosus* var. *callosus*.
n- Involucral bract appearing as an extension of the culm beyond the point where the inflorescence appears; inflorescence usually of more than one spikelet.
o- Annuals without rhizomes, commonly cespitose.....14. *S. purshianus*.
o- Perennials with elongate rhizomes, culms commonly scattered, not cespitose.
p- Spikelets sessile, closely adhering to the culm; either solitary or in a tight glomerule.
q- Culms terete, leaves many and equalling the culm; achenes sharply triangular.....15. *S. subterminalis*.
q- Culms triangular, leaves fewer and not equalling the culm; achenes planoconvex.
r- Culms usually slender, obtusely triangular, the single involucral bract acute, 2–15 cm. long and much surpassing the inflorescence; scales of the spikelet with a prominent awn projecting beyond the cleft apex
16. *S. americanus*.
r- Culms usually stout, acutely triangular, the single involucral bract

bluntish, 1–1.5 cm. long and only slightly surpassing the inflorescence; scales of the spikelet with a short, inconspicuous mucro extending from the more nearly entire apex.....17. *S. olneyi*.

p- Spikelets not sessile; solitary or in glomerules at the ends of elongate rays.

s- Culm terete; involucral bract terete.

t- Spikelets ovoid; achene 2 mm. long, the subtending scales hardly exceeding the mature achenes.....18. *S. validus* var. *creber*

t- Spikelets subcylindric; achene 2.5–3 mm. long, the subtending scales about one-third longer than the mature achenes.....19. *S. acutus*.

s- Culm below the inflorescence sharply triangular, more obtusely so farther down; involucral bract triangular.....20. *S. etuberculatus*.

Treatment of the Species

1. SCIRPUS MARITIMUS L. VAR. FERNALDII (BICKN.) BEETLE. (Fig. 2; Map 1.)

Scirpus maritimus L. var. *fernaldii* (Bickn.) Beetle, Amer. Jour. Bot. **29:** 85, 1942 (in part); Beetle, N. Amer. Flora **18:** 484, 1947 (in part); Fernald, Gray's Man. ed. 8: 272, fig. 441, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 276, 1952 (in part).

Scirpus novae-angliae Britton, Britt. and Brown, Ill. Flora **3:** 509, 1898.

Scirpus fernaldii Bickn., Torreya **1:** 96, 1901.

Scirpus campestris Britton var. *novae-angliae* (Britt.) Fern. Rhodora **8:** 163, 1906.

Scirpus campestris Britton var. *fernaldii* (Bickn.) Bartlett, Rhodora **8:** 163, 1906.

Scirpus robustus Pursh var. *novae-angliae* (Britton) Beetle, Amer. Jour. Bot. **29:** 87, 1942 (in part); Beetle, N. Amer. Flora **18:** 485, 1947 (in part).

Distribution: Rare in fresh to brackish marshes along the coast, Nova Scotia to South Carolina.

Notes: Scirpus maritimus var. *fernaldii* is a very local plant in North Carolina and is known from only one locality: CRAVEN CO.: in marsh of Jack Smith Creek along Oaks Road, w. edge of New Bern, June 11, 1952, *Whitford 297a* (NCS). The North Carolina plant is coarse with a spreading inflorescence of large cylindric-acute, castaneous spikelets, mostly in glomerules, at the ends of smooth rays. It corresponds to Britton's *Scirpus novae-angliae*, described in 1898, which was later considered a variety of *S. campestris* by Fernald (1906). At the same time, *Scirpus fernaldii*, a somewhat similar plant, was considered another variety of *S. campestris* by Bartlett. Beetle (1942), realizing the weak affinity of *Scirpus novae-angliae* and *S. fernaldii* to *S. campestris*, considered the former a variety of *S. robustus* (*S. robustus* var. *novae-angliae*) and the latter a variety of *S. maritimus* (*S. maritimus* var. *fernaldii*). Later, however, Fernald (1943a) considered the degree of distinction between *Scirpus novae-angliae* and *S. fernaldii* as not sufficient to segregate them and treated them together as *S. maritimus* var. *fernaldii*. *Scirpus maritimus* and its allies exhibit a high degree of variability and this has led to much confusion within the group. However, using characters here considered more stable, i.e. the trigonous achenes, the cylindric-acute, castaneous spikelets and the grouping of the spikelets in glomerules at the ends of long rays, it is perhaps better to treat the entity under discussion as being a variety of *Scirpus maritimus* rather than *S. robustus*. This taxon is here reported for the first time for North Carolina.

2. SCIRPUS ROBUSTUS PURSH. (Fig. 1; Map 1.)

Scirpus robustus Pursh, Fl. Amer. Sept. **1:** 56, 1816; Small, Man. S. E. Flora, 170–171, 1933; Beetle, N. Amer. Flora **18:** 485, 1947; Fernald, Gray's Man. ed. 8: 271–272, fig. 440, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 275, 1952.

Distribution: Brackish to saline coastal marshes, Massachusetts to Florida, eastern Mexico and California and South America.

Notes: A wide-ranging species, *Scirpus robustus* is common along the coast of North Carolina, being confined mainly to brackish and saline marsh habitats. A collection from a presumably non-saline habitat in Bladen County indicates, however, that plants may be introduced into other areas at least temporarily. The allied *Scirpus maritimus* var. *maritimus* of Europe has been reported on ballast around coastal ports. As yet, however, no specimens from the North Carolina ports of entry have come to the attention of the author.

3. SCIRPUS EXPANSUS FERN. (Fig. 3; Map 2.)

Scirpus expansus Fern., Fernald, Rhodora **45:** 293, 1943; Fernald, Gray's Man. ed. 8: 273, fig. 444, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 277–278, 1952; Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953.

Scirpus sylvaticus of many American authors (not L.), including Small; Small, Man. S.E. Flora, 171, 1933.

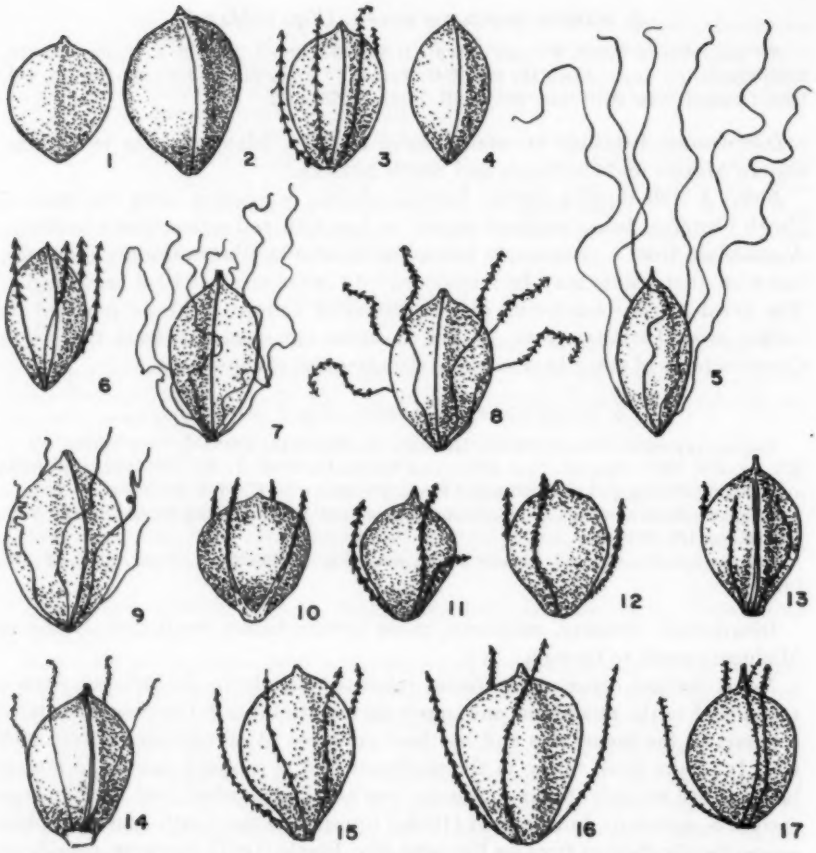
Scirpus sylvaticus L. var. *bissellii* Fern., sensu Beetle; Beetle, N. Amer. Flora **18:** 488, 1947.

Distribution: Swamps, meadows, moist stream banks, southwest Maine to Michigan, south to Georgia.

Notes: Scirpus expansus, a species restricted mainly to the Atlantic States, is confined to the mountains and upper piedmont in North Carolina. It is most common in the mountains and has been collected at an altitude of over 4000 feet. It occurs more rarely in the piedmont and is confined mainly to stream banks. Until recently, *Scirpus expansus* was not distinguished from the Linnaean species *S. sylvaticus*, but Fernald (1943a) interpreted the North American plant as specifically distinct from its Eurasian ally. Beetle (1947), however, considered Fernald's *Scirpus expansus* as a variety of *S. sylvaticus* L. and categorized it under the varietal name *S. sylvaticus* L. var. *bissellii* Fern. This varietal name was first used by Fernald (1900) for a very local plant of New England with large radiating glomerules of spikelets 6–14 mm. long; he later treated it as a form of *Scirpus expansus* (1943a). Therefore, *Scirpus sylvaticus* L. var. *bissellii* of the current literature is in the sense of Beetle, not Fernald. The author of this paper is in agreement with Fernald in considering *Scirpus expansus* as a specific entity (see Rhodora 45: 294, 1943a).

4. SCIRPUS ATROVIRENS WILLD. VAR. ATROVIRENS. (Fig. 6; Map 3.)

Scirpus atrovirens Willd. var. *atrovirens*, Willdenow, Enum. Pl. **1:** 79, 1809; Small, Man. S.E. Flora, 171, 1933; Fernald, Gray's Man. ed. 8: 273–274, fig. 445, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 277, 1952; Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953.



FIGS. 1–17: *Scirpus* achenes. FIG. 1. *S. robustus*. × 7. FIG. 2. *S. maritimus* var. *fernaldii*. × 9. FIG. 3. *S. expansus*. × 25. FIG. 4. *S. atrovirens* var. *georgianus*. × 25. FIG. 5. Generalized achene of *S. cyperinus* complex and *S. longii*. × 28. FIG. 6. *S. atrovirens* var. *atrovirens*. × 25. FIG. 7. *S. lineatus*. × 27. FIG. 8. *S. polyphyllus*. × 28. FIG. 9. *S. divaricatus*. × 30. FIG. 10. *S. purshianus*. × 14. FIG. 11. *S. americanus*. × 9. FIG. 12. *S. olneyi*. × 9. FIG. 13. *S. subterminalis*. × 9. FIG. 14. *S. cespitosus* var. *callosus*. × 13. FIG. 15. *S. validus* var. *creber*. × 14. FIG. 16. *S. acutus*. × 12. FIG. 17. *S. etuberculatus*. × 9.

Scirpus atrovirens Willd., *sensu* Beetle (in part); Beetle, N. Amer. Flora **18**: 486–487, 1947.

Distribution: Swamps, meadows and low ground, southern Quebec to Saskatchewan south to Georgia, Tennessee, and Missouri.

Notes: According to the material at hand, *Scirpus atrovirens* var. *atrovirens* is not common in North Carolina. Only two specimens of this variety have come to the attention of the author, these having been collected in the western

part of the state: MITCHELL CO.: wet places, no date, *W. W. Ashe* (UNC); MITCHELL CO.: Toe River, western N. C., July 1893, *W. W. Ashe* (UNC). The next entity, *Scirpus atrovirens* var. *georgianus* is more abundant and occurs in many North Carolina counties.

In the past, the characters used to distinguish the two varieties have been the size of the spikelets, the degree of nodulose-septation of the leaf sheaths, and the degree of development of the perianth bristles. *Scirpus atrovirens* var. *atrovirens* is generally coarser with longer spikelets, 3.5–8 mm. in length, whereas *Scirpus atrovirens* var. *georgianus* is more slender with shorter spikelets, 2–4 mm. in length; the former has conspicuous nodulose-septation of the lower leaves and sheaths upon drying while those of the latter are generally not superficially nodulose-septate upon drying. *Scirpus atrovirens* var. *atrovirens* has well developed coarsely-barbed bristles which are about as long as the achene, whereas in *S. atrovirens* var. *georgianus* the bristles are absent, or, if present, are delicate and much shorter than the achene.

Typical plants of both entities occur, but, in the North Carolina material, the author has found many of the above characters not consistently associated with one variety or the other. Plants commonly occur that combine characters of both *Scirpus atrovirens* var. *atrovirens* and *S. atrovirens* var. *georgianus*. However, in regard to the perianth bristles, where they are as in the typical *Scirpus atrovirens* var. *atrovirens*, the rest of the characters of that variety seem always to be present. Yet, where the perianth bristles are absent or only very weakly developed as in the typical *S. atrovirens* var. *georgianus*, the other characters of both varieties are quite commonly found associated together on the same plant. Such variability accounts for Beetle's (1947) failure to recognize the varietal distinctions. However, recognizing the presence of clear-cut individuals in both taxa, and significant geographical segregation of them throughout the range, it seems better to distinguish the two varieties.

5. SCIRPUS ATROVIRENS WILLD. VAR. GEORGIANUS (HARPER) FERN. (Fig. 4; Map. 3.)

Scirpus atrovirens Willd. var. *georgianus* (Harper) Fern., Fernald, Rhodora **23**: 134, 1921; Fernald, Gray's Man. ed. 8: 273–274, fig. 446, 1950; Gleason, New Britt. and Brown Ill. Flora **1**: 277, 1952; Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953.

Scirpus georgianus Harper, Bull. Torr. Bot. Club **27**: 331, 1900; Small, Man. S.E. Flora, 171, 1933.

Scirpus atrovirens Willd., *sensu* Beetle (in part); Beetle, N. Amer. Flora **18**: 486–487, 1947.

Distribution: Habitat as the typical variety, Newfoundland and Ontario to Minnesota, south to Georgia, Tennessee and Arkansas.

Notes: This variety is widespread throughout the state and according to the collection data at hand it is most common in the piedmont. See discussion under *Scirpus atrovirens* var. *atrovirens*.

6. SCIRPUS POLYPHYLLUS VAHL. (Fig. 8; Map. 4.)

Scirpus polyphyllus Vahl, Enum. Pl. **2**: 274, 1806; Small, Man. S.E. Flora, 171, 1933; Beetle, N. Amer. Flora **18**: 486, 1947; Fernald, Gray's Man. ed. 8: 274, fig. 447, 1950; Glea-

son, New Britt. and Brown Ill. Flora **1:** 278, 1952; Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953.

Distribution: Swamps, marshes and low ground, New England to Illinois south to Georgia and Tennessee.

Notes: In North Carolina this clearly distinct species is for the most part restricted to the mountain district. However, it is known from a few widely scattered counties in the piedmont.

7. SCIRPUS DIVARICATUS ELL. (Fig. 9; Map 5.)

Scirpus divaricatus Ell., Elliott, Sk. Fl. S. Car. **1:** 88. t. 2 f. 4, 1816; Small, Man. S.E. Flora, 171, 1933; Beetle, N. Amer. Flora **18:** 489, 1947; Fernald, Gray's Man. ed. 8: 274, fig. 448, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 278, 1952.

Distribution: Low woods and swamps, eastern Virginia to Florida and Louisiana; Missouri.

Notes: In North Carolina this species is confined to the coastal plain and is recorded from but four counties: NASH, PITT, SAMPSON, and BLADEN.

8. SCIRPUS LINEATUS MICHX. (Fig. 7; Map. 6.)

Scirpus lineatus Michx., Michaux, Fl. Bor. Amer. **1:** 32, 1803; Small, Man. S.E. Flora, 171, 1933; Beetle, N. Amer. Flora **18:** 489–490, 1947; Fernald, Gray's Man. ed. 8: 274, fig. 449, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 278, 1952; Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953.

Distribution: Marshes and low meadows, Maine to Iowa, south to Florida, Alabama, Mississippi, Texas; Colorado; Oregon.

Notes: In North Carolina, the writer has seen material of this species from but three localities, one in GRANVILLE COUNTY and two in DURHAM COUNTY. More extensive exploration should increase the known range in the state.

9. SCIRPUS CYPERINUS (L.) KUNTH VAR. CYPERINUS. (Fig. 5; Map 7.)

Scirpus cyperinus (L.) Kunth var. *cyperinus*, Kunth, Enum. Pl. **2:** 170, 1837; Small, Man. S.E. Flora, 171, 1933; Beetle, N. Amer. Flora **18:** 491, 1947; Fernald, Gray's Man. ed. 8: 275, fig. 451, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 276, 1952; Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953.

Eriophorum cyperinum L. Sp. Pl. ed. 2: 77, 1762.

Scirpus thyrsiflorus Willd. Enum. Hort. Berol. **1:** 78, 1809 (in part).

Scirpus eriophorum Michx. var. *cyperinus* A. Gray, Man. ed. 2: 501, 1856.

Distribution: Wet meadows, swamps and pond borders, New England west to Iowa, south to North Carolina, Tennessee and Oklahoma.

Notes: Scirpus cyperinus (L.) Kunth and its allies constitute a very difficult group within the genus *Scirpus*. Three entities occur within the state: *Scirpus cyperinus* var. *cyperinus*, *S. cyperinus* var. *eriophorum* (Michx.) Kuntze, and *S. cyperinus* var. *pelius* Fern. It is often difficult to distinguish the different categories owing to the high degree of variability which is commonly present, especially in areas where the range of one overlaps that of another. In such instances, intergradation of characters may be quite apparent. Yet, within a

broad population, distinct plants with constant characters occur. In the past, many authors have treated *Scirpus cyperinus* var. *cyperinus* as specifically distinct from *S. cyperinus* var. *eriophorum* (in which case it is usually known as *S. rubricosus* Fern.). *S. cyperinus* var. *pelius*, which in North Carolina occurs only in the mountains, has been considered either a variety of or synonymous with *S. cyperinus* var. *cyperinus*.

Scirpus cyperinus var. *cyperinus* is restricted to the mountain and piedmont districts in North Carolina, where its range overlaps that of *S. cyperinus* var. *eriophorum*. The latter has a statewide distribution. There seem to be no habitat differences between the two where the ranges overlap. In many areas of the lower piedmont, each entity has been found in close proximity to the other. In these areas, plants may also be found which have glomerate spikelets, characteristic of typical *Scirpus cyperinus* var. *cyperinus*, occurring in the same inflorescence with pedicellate spikelets of typical *S. cyperinus* var. *eriophorum*. Other characters of both, such as the color of the involucre, the involucels, and the spikelet scales frequently may also be found on the same plant. The above are traditionally used as "key characters," but with such variability they are considerably weakened. The more fundamental characters in this group, such as achene size, shape and surface markings, are essentially the same. Therefore, specific status for *Scirpus cyperinus* var. *cyperinus* and *S. cyperinus* var. *eriophorum* does not seem tenable. It is thought that resolution of the problem must await experimental evidence. Hence, it is perhaps best here to consider *Scirpus cyperinus* as comprising a single polymorphic species. In North Carolina, then, this is represented by *Scirpus cyperinus* var. *cyperinus*, *S. cyperinus* var. *eriophorum* and *S. cyperinus* var. *pelius*, each of which has a more or less significant geographical range along with a fair amount of constancy as to inflorescence structure and color.

10. SCIRPUS CYPERINUS (L.) KUNTH VAR. PELIUS FERN. (Fig. 5; Map 8.)

Scirpus cyperinus (L.) Kunth var. *pelius* Fern., Fernald, Rhodora **8**: 164, 1906; Fernald, Gray's Man. ed. 8: 275, 1950.

Eriophorum cyperinum (L.) Kunth var. *pelium* (Fern.) Farwell, Rep. Mich. Acad. **19**: 253, 1917.

Distribution: Bogs, wet meadows and swamps, Newfoundland to Minnesota, south to New England, along the mountains to New Jersey, Pennsylvania, northern Maryland, West Virginia, North Carolina; northern Ohio, northern Indiana, northern Illinois and northeast Iowa.

Notes: Scirpus cyperinus var. *pelius* is here newly reported for North Carolina. The range is extended south from the mountains of West Virginia. In the past, some workers have treated this entity as identical with typical *Scirpus cyperinus* (Gilly, 1946; Beetle, 1947). However, *Scirpus cyperinus* var. *pelius* seems to have a rather clear-cut geographical segregation from its allies throughout most of its range. It is primarily characterized by the blackish involucels and involucral bases, the whitish to pale brownish bristles, and rather slender stature, as contrasted with the brownish to reddish involucels and involucral bases,

brownish to reddish bristles, and over-all coarser texture of *Scirpus cyperinus* var. *eriophorum* and *S. cyperinus* var. *cyperinus*. It therefore seems reasonable to retain its varietal status.

It is possible that *Scirpus cyperinus* var. *pelius* may sometimes be interpreted as having a closer affinity to the northern *S. atrocinctus* Fern. than to *S. cyperinus*. *Scirpus atrocinctus* and *S. cyperinus* var. *pelius* have a somewhat similar range, are alike as to the blackish involucels and involucral bases and the whitish wool, and seem to have the same slender habit of growth. *Scirpus cyperinus* var. *pelius* has glomerate spikelets and *S. atrocinctus* has pedicellate spikelets but the structure of the spikelet groups can be quite variable in this section of the genus and perhaps is too artificial a character to be used with much confidence.

11. SCIRPUS CYPERINUS (L.) KUNTH VAR. ERIOPHORUM (MICHX.) O. KTZE. (Fig. 5; Map 9.)

Scirpus cyperinus (L.) Kunth var. *eriophorum* (Michx.) O. Ktze., Kuntze, Rev. Gen. Pl. 757, 1891; Beetle, N. Amer. Flora **18:** 491, 1947.

Scirpus eriophorum Michx. Fl. Bor. **1:** 33, 1803; Small, Man. S.E. Flora, 172, 1933.

Scirpus thyrsiflorus Willd. Enum. **78,** 1809 (in part).

Scirpus rubricosus Fern. Rhodora **47:** 124, 1945; Fernald, Gray's Man. ed. 8: 275, fig. 453, 1950; Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953.

Scirpus cyperinus (L.) Kunth var. *rubricosus* (Fern.) Gilly, Iowa State College Jour. of Science **21:** 82, 1946.

Distribution: Swamps, wet meadows, low woods and pond borders, coastal plain, Bass River, New Brunswick, southeast Massachusetts to Florida, west to Iowa and Texas.

Notes: In North Carolina, *Scirpus cyperinus* var. *eriophorum* is more commonly restricted to the coastal plain but it also occurs in scattered communities in the mountain and piedmont districts. See note under *S. cyperinus* var. *cyperinus*.

12. SCIRPUS LONGII FERN. (Fig. 5, Map. 8.)

Scirpus longii Fern., Fernald, Rhodora **13:** 6, 1911; Beetle, N. Amer. Flora **18:** 491–492, 1947; Fernald, Gray's Man. ed. 8: 276, fig. 456, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 276, 1952.

Distribution: Locally abundant, meadows, swamps, fresh marshes, western Nova Scotia, eastern Massachusetts to southern New Jersey; eastern North Carolina.

Notes: A very coarse species, *Scirpus longii* reaches in North Carolina the southernmost limit of its range. The nearest station to the north is in New Jersey. But one North Carolina station is known for this plant, in LENOIR CO.: 1½ miles s.e. of Kinston, wet sand bordering pond, August 8, 1922, *Randolph & Randolph 579* (G). It differs from all other related entities in the same section of the genus, in its glutinous or glandular involucre, its large spikelets with long scales, its long anthers and very long whitish perianth bristles, and its characteristic reddish to castaneous achenes.

13. SCIRPUS CESPITOSUS L. VAR. CALLOSUS BIGEL. (Fig. 14; Map. 10.)

Scirpus cespitosus L. var. *callosus* Bigel., Bigelow, Pl. Bost. ed. 2: 21, 1824; Beetle, N. Amer. Flora **18:** 494, 1947; Fernald, Gray's Man. ed. 8: 267, fig. 425, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 271, 1952.

Scirpus cespitosus of many American authors including Small, (not L.); Small, Man. S.E. Flora, 171, 1933.

Distribution: Acid bogs and peat, Arctic regions south to Newfoundland, Nova Scotia, Maine; locally, western New York, northern Michigan, Illinois, Minnesota, Montana, Utah, and Washington; higher mountains of New England, North Carolina, Tennessee and Georgia.

Notes: Scirpus cespitosus var. *callosus* is an extremely localized plant in North Carolina, found only on the higher mountain ridges and summits in the western part of the state. Farther north it is more abundant, forming dense mats in the tundra regions of the Arctic. Typical *Scirpus cespitosus* var. *cespitosus* of lowland Europe differs from *S. cespitosus* var. *callosus* in the notched orifice of the upper sheath, purple spikelets, and the upwardly barbed bristles.

14. SCIRPUS PURSHIANUS FERN. (Fig. 10, Map 11.)

Scirpus purshianus Fern., Fernald, Rhodora **44:** 479, 1942; Fernald, Gray's Man. ed. 8: 268, fig. 429, 1950; Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953.

Scirpus debilis Pursh, Fl. Amer. Sept. 55, 1814, (not *Scirpus debilis* Lam., 1791); Small, Man. S.E. Flora, 169–170, 1933.

Scirpus smithii Gray var. *williamsii* (Fern.) Beetle, Amer. Jour. Bot. **29:** 655, 1942; Beetle, N. Amer. Flora **18:** 498, 1947; Gleason, New Britt. and Brown Ill. Flora **1:** 273, 1952.

Distribution: Shores, bogs and swamps, southwest Maine to Minnesota, south to Georgia, Alabama and Kentucky.

Notes: In North Carolina, *Scirpus purshianus* is most abundant in the mountain district but several piedmont localities have been recorded, notably, one in Person County. This species has been interpreted as a variety of *Scirpus smithii* Gray (Beetle, 1942a; Gleason, 1952), but it seems clear that the two are specifically distinct (see Fernald, Rhodora 44: 479–483, 1942). *Scirpus smithii* does not extend as far south as *S. purshianus*, and it reaches its southern limit from northeast Virginia, to northwest Pennsylvania, northern Ohio, northern Indiana and Illinois.

15. SCIRPUS SUBTERMINALIS TORR. (Fig. 13.)

Scirpus subterminalis Torr., Torrey, Fl. No. and Midl. U.S. **1:** 47, 1824; Small, Man. S.E. Flora, 169, 1933; Beetle, N. Amer. Flora **18:** 500, 1947; Fernald, Gray's Man. ed. 8: 269, fig. 431, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 273, 1952.

Distribution: Ponds, streams, deadwaters (often acid), Newfoundland, southern Alaska and British Columbia, south to eastern Georgia, Michigan, northern Indiana, northern Illinois, Missouri, Montana, Idaho and Oregon.

Notes: Scirpus subterminalis is for the most part aquatic and has flaccid culms and floating leaves. The record of this species for North Carolina is

based on a single specimen collected by Knieskern, which is on deposit in the Gray Herbarium. Information on the specimen label is meager but the notation "Nor. Caro." seems clearly to indicate that the plant was collected in North Carolina. Although the range of *Scirpus subterminalis* includes southeastern Virginia and South Carolina, this species is here reported for the first time for the state.

16. SCIRPUS AMERICANUS PERS. (Fig. 11; Map 12.)

Scirpus americanus Pers., Persoon, Syn. Pl. **1:** 68, 1805; Small, Man. S.E. Flora, 170, 1933; Beetle, N. Amer. Flora **18:** 501, 1947; Fernald, Gray's Man. ed. 8: 269–270, fig. 433, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 272, 1952.

Scirpus triqueter, sensu Michx. Fl. Bor. Amer. **1:** 30, 1803. Not *Scirpus triqueter* L. 1753 (Eurasian).

Scirpus pungens Vahl, Enum. **2:** 255, 1806.

Distribution: Wet shores and shallow water (sometimes brackish), Newfoundland to Minnesota, south to Florida and Texas.

Notes: Scirpus americanus in North Carolina is confined to fresh (sometimes brackish) shores and marshes along the coast. No inland stations have been reported for the state, although further north, in its over-all range, this species has been collected from many inland localities. *Scirpus americanus* is sometimes confused with the next species, *S. olneyi* Gray, but they are clearly distinct species. *Scirpus americanus* is usually more slender, up to 1.5 m. high, and with culms 1–6 mm. wide, while *S. olneyi* is coarser, up to 3 m. high, and with culms 4–10 mm. wide: *Scirpus americanus* has triangular culms with flattish sides, *S. olneyi* has triangular culms with sharply concave sides; the involucral bract in *S. americanus* is generally longer (3–12 cm. long) while that in *S. olneyi* is generally shorter (1–5 cm. long); the spikelet scales of *S. americanus* are generally broadly ovate with the midrib extending beyond the 2-cleft apex as a conspicuous mucro, while in *S. olneyi* the scales are generally suborbicular with only a short, inconspicuous mucronulate point.

17. SCIRPUS OLNEYI GRAY. (Fig. 12; Map 13.)

Scirpus olneyi Gray, Bost. Jour. Nat. Hist. **5:** 238, 1845; Small, Man. S.E. Flora, 170, 1933; Fernald, Gray's Man. ed. 8: 270, fig. 434, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 272, 1952.

Scirpus chilensis Meyen, Reise Erd. **1:** 380, 1834, nomen; et. Nees and Meyen, Linnaea **9:** 293, 1834, nomen; Nees in Meyen, Act. Acad. Cur. **19:** 93, suppl. 1843 (*sensu* Beetle in part); Beetle, N. Amer. Flora **18:** 500, 1947.

Distribution: Fresh to brackish and saline marshes, western Nova Scotia, New Hampshire south to Florida and Mexico; saline stations inland: New York, northern Ohio, southern Michigan, Missouri, Wyoming, Idaho, Oregon.

Notes: Scirpus olneyi is probably more widespread along the North Carolina coast than present distribution records seem to indicate. Beetle (1943) lumps this species with the South American *Scirpus chilensis* of Nees and Meyen. However, as Fernald has pointed out (1943b), *S. olneyi* seems clearly to be specifically distinct.

18. SCIRPUS VALIDUS VAHL VAR. CREBER FERN. (Fig. 15; Map 14.)

Scirpus validus Vahl var. *creber* Fern., Fernald, Rhodora **45:** 283, 1943; Fernald, Gray's Man. ed. 8: 270, fig. 435, 1950.

Scirpus lacustris of many American authors, not *S. lacustris* L. (1753).

Scirpus lacustris var. *condensatus* Peck, Ann. Rep. N.Y. State Mus. **53:** 853, 1900.

Scirpus validus Vahl, Enum. Pl. **2:** 268, 1806; Small, Man. S.E. Flora, 170, 1933 (in part); Beetle, N. Amer. Flora, **18:** 503, 1947 (in part); Gleason, New Britt. and Brown Ill. Flora **1:** 273, 1952 (in part); Blomquist and Oosting, Spring and Early Summer Flora, Piedmont, N. C. ed. 5: 32, 1953 (in part).

Distribution: Fresh to occasionally brackish shallow water and marshes, Newfoundland to Alaska, south to Georgia, Tennessee, Missouri, Oklahoma, Texas, New Mexico, northern Mexico and California.

Notes: Scirpus validus var. *creber* is most abundant in the eastern part of the state, where it is restricted to fresh water marshes along the coast. In the mountain district, it is rather widespread but not abundant. Between the coastal marshes and the mountains, it is apparently rare, as only 2 collections have come to the author's attention and these not of recent date. Beetle (1947) and Gleason (1952) do not consider *Scirpus validus* var. *creber* as justifying varietal segregation and treat it as synonymous with the more tropical American *S. validus* var. *validus*. However, as Fernald (1943a) has indicated, most of the North American material is better treated as varietally distinct from the typical.

19. SCIRPUS ACUTUS MUHL. (Fig. 16; Map 15.)

Scirpus acutus Muhl., Muhlenberg, in Bigelow, Fl. Bost. 15, 1814; Beetle, N. Amer. Flora **18:** 503–504, 1947; Fernald, Gray's Man. ed. 8: 270–271, fig. 436, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 274, 1952.

Scirpus occidentalis Chase, Rhodora **6:** 68, 1904.

Distribution: Marshes, shores, and shallow water, Newfoundland to British Columbia and Alaska, south to North Carolina, Tennessee, Texas, New Mexico, Arizona and California.

Notes: This species is known from only 2 counties in North Carolina where it is locally abundant: CRAVEN CO.: Lake Ellis, July 21, 1908, *Ellis 47* (US); HYDE CO.: Lake Mattamuskeet, along causeway, growing in fresh water of lake, June 12, 1952, *Cappel & Godfrey 130* (NCS). More common further north and west, the North Carolina stations represent the southernmost range limit of *Scirpus acutus* along the eastern seaboard.

20. SCIRPUS ETUBERCULATUS (STEUD.) KUNTZE. (Fig. 17; Map 16.)

Scirpus etuberculatus (Steud.) Kuntze, Rev. Gen. **2:** 758, 1891; Small, Man. S.E. Flora, 170, 1933; Beetle, N. Amer. Flora **18:** 499–500, 1947; Fernald, Gray's Man. ed. 8: 271, fig. 438, 1950; Gleason, New Britt. and Brown Ill. Flora **1:** 274, 1952.

Scirpus maritimus var. *cylindricus* Torr., Ann. Lyc. N.Y. **3:** 325, 1836.

Rhynchospora etuberculata Steud., Syn. Pl. Cyp. 142, 1855.

Scirpus leptolepis Chapm., Fl. S. U.S., 520, 1860.

Scirpus canbyi A. Gray, Canby, Proc. Acad. Phila. 18, 1864.

Scirpus cylindricus Britton, Trans. N.Y. Acad. **11:** 79, 1892.

Distribution: Pond borders, fresh to brackish marshes, locally, Delaware to Florida and Louisiana; Missouri.

Notes: A very localized plant throughout its range, *Scirpus etuberculatus* is typically a coastal plain species and is known only from 4 counties in North Carolina: CRAVEN CO., HYDE CO., NEW HANOVER CO., and WAYNE CO.

SUMMARY

This paper consists of a study of the genus *Scirpus* in North Carolina with emphasis on its taxonomy and distribution. A review of the literature indicates that no all-inclusive treatment for the state has been made since 1867.

Over 900 specimens have been examined during the course of the study. The source of this material has been from the larger herbaria of the eastern United States as well as from the author's own collections in the field.

In all, twenty taxa in the genus *Scirpus* have been found to occur in North Carolina. Three of these are here reported as new for the state. The systematic treatment includes a description of the genus, a key to the North Carolina entities, and discussion of the problems encountered in the difficult groups.

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A SYNOPSIS OF JATROPHA, SUBSECTION EUCURCAS, WITH THE DESCRIPTION OF TWO NEW SPECIES FROM MEXICO

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Subsection *Eucurcas* of the euphorbiaceous genus *Jatropha* was treated by McVaugh (1945b) as being comprised of three species. One of these, *J. curcas*, is now widespread in the tropics of both hemispheres. Its original range is difficult to determine since it was widely cultivated by the American aborigines long before the arrival of the Spaniards who then carried it into the Old World tropics. However, it was without doubt part of the flora of Mexico and probably northern Central America before the arrival of Cortez and it most likely originated there. The other two species treated by McVaugh as belonging to this subsection have been but rarely collected and then only in Mexico. The subsection hence appears to be one which originally was nearly or completely restricted to Mexico.

The present study was begun after finding it impossible to identify a tree from southwestern Jalisco belonging to the genus *Jatropha*. It was not included in either Standley's (1923) or McVaugh's (1945b) account of the genus. McVaugh's synopsis indicated that the taxonomy of the small subsection to which the Jaliscan tree belongs was not well understood, owing to the rarity of two of its three species. The types of the two rare species were unavailable at the time of McVaugh's investigation and he had to rely upon comparatively unsatisfactory photographs. Dr. K. H. Rechinger of the Naturhistorisches Museum, Vienna, and Dr. O. Hagerup of the Botaniske Museum, Copenhagen, kindly lent these types to me and I wish to acknowledge my appreciation and indebtedness to them for this courtesy. The few specimens available of the two rare species were kindly lent to me by the curators of the herbaria listed at the end of this paragraph. The letters used to indicate these herbaria throughout the paper are those recommended by Lanjouw and Stafleu (1952): (C) Universitets Botaniske Museum, Copenhagen, Denmark; (F) Chicago Natural History Museum, Chicago, Illinois; (GH) Gray Herbarium of Harvard University, Cambridge, Massachusetts; (K) Royal Botanic Gardens, Kew, England; (MICH) University of Michigan, Ann Arbor, Michigan; (NY) New York Botanical Garden, New York, New York; (UC) University of California, Berkeley, California; (US) United States National Herbarium, Washington, D. C.; (W) Naturhistorisches Museum, Vienna, Austria.

The two species here proposed as new are known from but one collection each and the specimens are in both instances incomplete. Still there can be no doubt that they are distinct and can be well enough characterized at present so that it seems advisable to describe them now. The history of the rarer species in this subsection is such that one can scarcely expect that collections providing the information now lacking will be forthcoming in the near future. The rarest of the three previously described species, *J. andrieuxii*, was first collected more

than one hundred years ago and has been found but once since, over fifty years ago. The specimen upon which the original description was based is meager and the more recent collection is such that there is still much to be learned about the gross morphology of this species. The other rarely collected and previously described species in this subsection, *J. pseudo-curcas*, has been collected not more than a half dozen times. Those two species and the two new ones as well are all probably rare and near extinction today, as their range is apparently only that region of Mexico which has had its vegetation largely depleted or completely destroyed in the past few hundred years.

JATROPHA L. subsect. EUCURCAS (Baill.) Muell. Arg. *in* DC. Prodr. **15**(2): 1080. 1866.

[for synonymy see McVaugh (1945b, p. 283)]

Monoecious (or one species possibly dioecious) shrubs or small trees; inflorescence either unisexual or bisexual, usually long-peduncled and the lowermost branch alternate, the staminate inflorescence many-flowered and becoming much-expanded, the pistillate subcapitate, the bisexual inflorescences resembling the staminate but with a few sessile pistillate flowers borne in the forks of the lowermost branches. Calyx-lobes imbricate, glandular-dentate or more commonly eglandular, those of the staminate flowers scarious whereas those of the pistillate at least twice as large and herbaceous. Stamineal column composed of two whorls of 5 stamens each. Primary style-branches typically 3, these in turn bifurcate and terminated by two knob-like or linear fungoid stigmas. Seeds elongate and sometimes flattened, not globose, light brown to black, hilum either flat or elevated.

TYPE SPECIES: *Jatropha curcas* L.

KEY TO SUBSECTION EUCURCAS

1. Venation neither extending beyond margin of leaf nor glandular-tipped; leaves glabrous or nearly so, or both surfaces nearly equally pubescent; calyx-lobes not glandular-toothed.
   2. Leaves and bracts scarcely, if at all, reticulate beneath, veins not prominently elevated; glabrous or nearly so to densely velvety villous-pubescent on both surfaces; hilum either flush with the testa or elevated.
      3. Leaves glabrous, glabrescent, or if sparsely pubescent not readily detected by touch; seeds flattened, smooth and brown or roughened with black ridges and pale depressed streaks, hilum even with seed-coat or elevated.
         4. Seeds crustose-striate, blackened, hilum conspicuously elevated into a beak 1–2 mm. long; filaments of the upper verticil glabrous or nearly so ..... 1. *J. curcas*.
         4. Seeds smooth, chestnut-brown, hilum flat, not elevated from the surface of the testa into a beak; filaments of the upper verticil copiously villous-pubescent ..... 2. *J. hintonii*.
      3. Leaves noticeably velvety-pubescent on both surfaces; seeds cylindrical, smooth and jet-black, hilum projecting onto a beak ..... 3. *J. pseudo-curcas*.
   2. Leaves and bracts conspicuously reticulate beneath, the veins prominently elevated,

densely tomentose on both surfaces; hilum not elevated from the surface of the seed-coat ..... 4. *J. andrieuxii*.

1. Venation extending about 1 mm. beyond the margin of the blade and glandular knob-tipped; the leaves glabrous or nearly so above except along the veins and at the margin but densely chalky-white pubescent beneath; calyx-lobes glandular-toothed 5. *J. bartlettii*.

1. *Jatropha curcas* L., Sp. Pl. 1006. 1753

This is by far the best known species of the subsection. Its synonymy is lengthy and so well-understood as not to warrant inclusion here. The combination of glabrous or nearly glabrous leaves and petioles, black roughened crustose-striate seeds with an elevated hilum, and the glabrous or only slightly villous filaments of the upper verticil is one that is not duplicated in any other species in the subsection.

The herbage of *J. curcas* is unpalatable to livestock. For that reason, together with its utility in the native economy, this plant is often used in hedges. Standley and Steyermark (1949) report that, among other uses, it is employed by the natives as the host of a lac-producing scale-insect, and that the seeds, in addition to being eaten after roasting, are the source of a considerable quantity of oil used for illumination and in soap-making. The usefulness of the plant is doubtlessly responsible for its present widespread distribution. It is known from Mexico, Central America, the Antilles, South America and from numerous localities throughout the tropics of the Old World. Variation in leaf-shape, pubescence, and in marking of the seed-coat have all been noted but the significance of these differences is as yet undetermined.

The key characters of leaf shape employed by Standley and Steyermark (1949) in the Flora of Guatemala, to distinguish *J. gaumeri* Greenm. (belonging to subsection *Mozinna* according to McVaugh) from *J. curcas*, are not valid. Many specimens of *J. curcas* possess "entire" leaves rather than "shallowly angulate-lobate" as stated in that Flora. *Jatropha gaumeri* was known to McVaugh only from the Yucatan Peninsula. The entire-leaved form of *J. curcas* is known from Guatemala and that form has been treated as a distinct species by two different authors (see McVaugh, 1945a p. 35).

McVaugh (1945b) proposed that *J. curcas* as it is represented in the area from Colima to Sinaloa be given varietal rank (*J. curcas* var. *rufus* McVaugh) as it seemed to differ "from the usual type by the development of a considerable amount of flocculent reddish tomentum, especially in the inflorescence." Furthermore he added that "occasional individuals from the area between Guerrero and Guatemala approach it in degree of pubescence and may likewise represent a part of the native population of this species." Several specimens from Guerrero, Chiapas and Guatemala seem indistinguishable from an isotype of the proposed variety and it would seem impossible to exclude those plants from the entity if it is to be recognized. However, judging from the small number of specimens of this species examined, it would seem very difficult to maintain the varieties as the differences are such that the two readily distinguishable extremes appear to be connected by a complete gradation of intermediate forms.

2. Jatropha hintonii sp. nov.*

Monoecious shrub 1.5 m. high. Leaves in the dried state brittle, thin, chartaceous, the texture like that of *J. curcas*, cordate or somewhat 3-lobed, as long as broad or nearly so, rarely longer, 10–20 cm. long, 10–22 cm. wide, sparsely yet evenly covered with short, hyaline, strigulose pubescence on both surfaces, the hairs 0.1–0.5 mm. long, the pubescence of principal veins more abundant, tawny and curling. Margin of leaf entire, the veins not extendent. Base of leaf varying from almost truncate to deeply and narrowly notched at the petiolar sinus. Petiole 5–12 cm. long, 1–2 mm. in diameter varying from almost glabrous to rather evenly densely tawny pubescent. Older portion of branch 4–5 mm. in diameter, glabrous, dull reddish-brown, hollow in the dried specimens; younger growth varying from glabrous to densely short, tawny, curly pubescent. Principal veins 7, palmate. Inflorescence bisexual, 10–15 cm. high, 2–4 (or up to 8 in fruit) cm. broad, the lower branches alternate. Peduncles 4–10 cm. long, 1–2 mm. in diameter, varying from almost glabrous to densely short tawny pubescent like the inflorescence branches. Pedicels densely short tawny pubescent, 1–7 mm. long, the pistillate elongating up to 6 cm. in young fruiting material. Bracts small, 2–4 mm. long, 1–2 mm. wide, densely tawny pubescent.

Staminate flowers: Sepals 5, scarious, imbricate, oblong, obtuse, 3–4 mm. long, 2–2.5 mm. wide, glabrous, margins eglandular entire. Corolla 6–8 mm. high, externally glabrous, internally densely long villous with interwoven hyaline hairs. Petals 5, apparently completely distinct, the tips reflexed at anthesis. Staminodial knobs 5, slender, finger-like, pinkish, 1–1.5 mm. high, 0.2–0.4 mm. in diameter, the apex arching slightly outwardly. Androecial column 6–8 mm. high, the anthers borne in two verticils, usually of 5 each. Filaments of the lower verticil separating from the column about 2–3 mm. above the base, the free portion about 2 mm. long, glabrous or rarely somewhat pubescent along attachment at backs of the anthers. Filaments of the upper verticil 1–1.2 mm. long, densely villous as are the backs of the anthers. Anthers about 2 mm. long, 1.5 mm. wide, dehiscing laterally.

Pistillate flowers: Sepals 5, imbricate, herbaceous, densely short pubescent on both surfaces, 5–9 mm. long, 2–4 mm. wide, elliptic to somewhat rhombic, eglandular. Corolla polypetalous but appearing gamopetalous due to the copious interwoven villosity within, externally glabrous, petals 5. Staminodial glands 5, flat, broadly oblong, about 1 mm. long and 1–2 mm. broad, contiguous thus completely enclosing base of ovary. Ovary globose, 3–3.5 mm. high, about 3 mm. in diameter. Style united for about 2–2.5 mm., trifurcating into style-branches 1–1.5 mm. long, each branch bifurcating into a fleshy linear stigmatic surface about 1 mm. long. Seeds smooth, somewhat flattened, broadly oblong, 13–15 mm. long, 10–12 mm. wide, 6–7 mm. thick, chestnut-brown with areas darkening into black; hilum flat, not elevated from the surface of the testa, light brown, deltoid; micropyle immediately above hilum and covered by a flat scale-like caruncle.

TYPE: By roadside, 1050 m., between Salitre and Cañitas, district of Temascaltepec, E. de México, Mexico. July 10, 1933. *G. B. Hinton 4300* (GH). Isotypes examined: (F, K, US.).

* Jatropha hintonii sp. nov. Frutex monoicus, circa 1.5 m. altus. Folia subglabra, textura ut in *J. curcas*. Inflorescentia bisexualis, longe pedunculata. Calyx imbricatus, masculinus scariosus, sed foemineus herbaceus. Corolla utriusque sexus intus villosa. Stamina 10, biverticillata. Filamenta interiora villosa. Stigmata bipartita, carnosa, linearis, c. 1 mm. longa. Semina laevia, brunea, 13–15 mm. longa, 10–12 mm. lata, 6–7 mm. crassa; hilum non elevatum sed planum.

The only collections of this species known were made by Hinton about seventy-five miles southwest of Mexico City more than twenty years ago. The specimens are not complete so that many of the morphological features of the new species are unknown. The duplicates were originally distributed from Kew as *J. curcas* and vegetatively *J. hintonii* is strikingly similar to that species. However, Hinton's specimens are accompanied by numerous loose seeds which are smooth, chestnut-brown, and with the hilum not at all elevated above the surface of the seed-coat. These seed characters are in strong contrast to the blackish roughened crustose-striate seeds possessing a conspicuously beaked or elevated hilum that are found in *J. curcas*.

In McVaugh's synopsis of the genus, Hinton's collection apparently formed the largest part of his concept of *J. pseudo-curcas*. Most of the characters presented for that species could only have been observed from the specimens collected by Hinton which were annotated and cited by McVaugh as *J. pseudo-curcas*. *J. hintonii* differs markedly from *J. pseudo-curcas* which possesses velvety-tomentose leaves and black, cylindrical seeds with an elevated hilum. Both leaf-surfaces of *J. hintonii*, especially when young, are sparsely strigulose with short, hyaline pubescence and *J. curcas* is typically glabrous. However, it doubtlessly will be difficult, if not impossible, to differentiate between specimens of *J. curcas* and *J. hintonii* in the absence of seeds. The differences in the seeds of the two species are of such magnitude, however, that there can be no doubt as to the distinctness of the two species, and other characters may be discovered in more complete specimens.

3. *Jatropha pseudo-curcas* Muell. Arg., Linnaea **34**: 208. 1865

Monoecious shrub or small tree. Branches of the current season densely short, pale-tawny tomentose, the older branches glabrous with reddish-brown bark. Leaves cordate, palmately 3–5-lobed or more rarely unlobed, the petiolar sinus deep and narrow to broad and shallow. Blade 8–18 cm. long, 8–19 cm. wide, entire, the veins not extending beyond the margin, both surfaces densely velvety-tomentose with copious short soft hyaline hairs persisting through maturity, pubescence of the principal veins strikingly characterized on the lower surface by being denser and strongly spreading at right angles from the veins. Petiole 3–11 cm. long, 2–3 mm. in diameter, densely short pubescent or somewhat glabrescent at maturity. Inflorescence bisexual, axillary, borne on the current year's growth, 6–17 cm. long, 3–10 cm. broad. Peduncles 2–9 cm. long, 1.5–3 mm. in diameter, short tawny tomentose; the lowermost branches of the inflorescence alternate, those above becoming opposite or subopposite. Bracts subtending inflorescence branches foliaceous, 1.5–3 (6) cm. long, 0.4–0.9 (1.8) cm. wide, gradually reduced above, conspicuously tomentose.

Staminate flowers: Sepals 5, imbricate, slightly unequal, scarious, margins entire, eglandular, acute to obtuse, oblong to somewhat elliptical or ovate, 4-6 mm. long, 2–3 mm. wide, both surfaces densely hyaline-hirsute. Corolla 5–8 mm. long, externally glabrous, internally densely long villous. Petals 5, apparently

separate but appearing gamopetalous below from the interwoven hyaline villosity, imbricate, oblong, obtuse, 5–8 mm. long, 2–3 mm. wide. Androecium of 10 stamens in 2 verticils of 5 each, outer verticil departing from stamineal column about 2 mm. from base, the inner verticil of filaments separating about 4 mm. from receptacle, filaments glabrous or slightly villous, anthers 1.5–2 mm. long. Staminodial lobes 5, finger-like, slender, glandular, 1.2–1.5 mm. long, about 0.2–0.5 mm. wide, curving slightly outward at the apex.

Pistillate flowers: Sepals 5, imbricate, unequal, separate, foliaceous, acute to obtuse, elliptic to somewhat ovate, densely short puberulent on both surfaces, eglandular, 7–14 mm. long, 2–6 mm. wide. Petals 5, imbricate, apparently entirely separate but appearing united due to the densely interwoven villosity within, completely glabrous without, linear to elliptic to narrowly oblong, more or less acute, 6–10 mm. long, 1.5–2.5 mm. wide. Staminodial lobes surrounding the ovary 5, flat, obtuse, oval, apparently glandular, about 1 mm. high and 1 mm. wide, margins not contiguous. Ovary trigonous, 2–3 mm. long, surmounted by a united style about 2 mm. long which trifurcates (or only bifurcates) into divisions about 2 mm. long the last 1.5 mm. of which being the deeply bifurcated, linear, fungoidal stigmatic surfaces. The two mature (?) bilocular fruits measuring 20 and 22 mm. long, 9–14 mm. in diameter surmounted by the 2 mm. persistent base of the style. Seeds smooth, shiny, jet-black, almost cylindrical about 15 mm. long, 7 mm. in diameter, hilum half projecting onto the 2 mm. beak on the back of which is a fringed caruncle-like growth.

TYPE: Near Oaxaca, Oaxaca, Mexico. May, 1842. *Liebmann 5644.* (C!) There are three sheets of this collection at Copenhagen, the best of which was used in preparing the "phototype" for the Chicago Natural History Museum series (FM Neg. 21554).

This species is known to me with certainty only from the mountains about the city of Oaxaca, and from those mountains bordering the Rio Atoyac to the south. In addition to Liebmann's type mentioned above, two other collections of this species have been seen from Oaxaca. (La Cienaga, a 1530 metros, Distrito de Zimaflan, 30 Marzo 1937. *Conzattii 5288* (MICH); Cercanias de Oaxaca, alt. 1550 m., Junio 1901. *Conzattii & Gonzalez 1207* (GH)).

Another collection referred to *J. pseudo-curcas* by McVaugh is *Purpus 8816* (UC) from the Barranca de Panoaya, Vera Cruz. That collection is essentially similar to those from Oaxaca in texture of leaf and in pubescence (particularly in regard to the striking feature of the hairs bordering the veins conspicuously extending at right angles from them) and in those features of the flower that can be determined from the very poorly developed inflorescence. In the absence of seeds or even more adequate flowering material absolute determination of that collection is at present impossible. The leaves are more or less cordate and entire in contrast to the conspicuously 3–5-lobed leaves of the Oaxacan specimens. Another collection, *Purpus 16167* (C), from a rocky barranco near Rancho La Palmilla, Vera Cruz, appears to be identical with *Purpus 8816*. The pubescence of these specimens from Vera Cruz differs somewhat from that of the collections

from Oaxaca in being considerably denser and of a more velvety texture. Until more adequate collections have been obtained from Vera Cruz their identification as *J. pseudo-curcas* is at best tentative.

The remaining collection cited by McVaugh, and that from which the majority of characters which he attributed to *J. pseudo-curcas* were derived, was *Hinton 4300*. Hinton's specimens have proved to be from a very distinct and previously undescribed species which has been described in this paper in honor of its collector.

4. *Jatropha andrieuxii* Muell. Arg., Linnaea **34**: 208. 1865

Shrub or small tree, probably monoecious. Leaves more or less orbicular in general outline, principal lobes 3, margin somewhat undulate or shallowly multilobed, texture rather thick, blade 10–22 cm. long, 10–23 cm. wide, densely soft velvety-tomentose on both the upper and lower surface, the pubescence hyaline, or along the principal veins tawny or rufous pubescent, the hairs 0.5–1 mm. long, straight or nearly so above, curly and interwoven beneath. Leaves prominently reticulate below from the elevated venation, veins neither glandular nor extending beyond the margin of the blade. Petiolar sinus usually deep and narrow. Petioles stout, 2–3 mm. in diameter, 2.5–12 cm. long, densely short tawny to rufous pubescent even at maturity. Inflorescences probably both unisexual and bisexual, lowermost branches alternate, at first rather compactly subcapitate, on densely tawny puberulent peduncles 7–14(23) cm. long, 1.5–3.5 mm. in diameter. Bracts foliaceous, densely velvety tomentose, venation conspicuously reticulate from elevated veins on the lower surface, elliptic to lanceolate, subpetiolate, the larger from 2.5–4 cm. long, 1–2 cm. wide at time of fruiting.

Staminate flowers: Sepals 5, separate, imbricate, scarious, rather densely hyaline-hirsute without and less densely short-puberulent within, elliptic to oblong, obtuse, 5–7 mm. long, 1.5–2.5 mm. broad. Petals 5, probably separate but appearing united owing to the copious interwoven villosity within, glabrous or nearly so without, elliptic to oblong, tip reflexed at anthesis, 6–8 mm. long, 2–3 mm. wide. Staminodial lobes at the base of the androecium 5, peg-like, blunt, non-contiguous, perhaps glandular, about 1 mm. long. Stamineal column completely glabrous, the 10 stamens in verticils of 5 each.

Pistillate flowers: Sepals 5, separate, somewhat unequal, foliaceous, imbricate, densely puberulent on both surfaces, becoming in fruiting material 1.4 cm. long and 9 mm. wide. Corolla not seen by me but Mueller reports it to be composed of separate petals which are villous within while McVaugh reports the petals as united for half their length and glabrous. Mature (?) fruit about 1.5 cm. long and 1 cm. in diameter, the columella persisting after dehiscence. Seeds about 12 mm. long, 8 mm. wide and 5 mm. thick, shiny, black or dark reddish-brown, the hilum not elevated, elliptical, obovate or somewhat lens-shaped, about 2 mm. long and 1.5 mm. wide. Caruncle-like growth covering micropyle black, lobed, about 1 mm. long and 2 mm. wide.

TYPE: Between Chila, Puebla and Huajuapan, Oaxaca. May. *Andrieux 114*. (w!) An isotype, deposited at Kew, has also been examined.

J. andrieuxii is known only from the original collection made by Andrieux in northwestern Oaxaca and from a collection made by Pringle in northern Guerrero (Mountains near Iquala [between Los Amates and Iquala] Guerrero, Mexico, 3000 ft. Oct. 24, 1900. *C. G. Pringle 9263* (GH!)).

This species has been collected but twice and unfortunately both Andrieux and Pringle encountered it at seasons in which only incomplete material was available. However, even from these two collections it is obvious that the entity described by Mueller is strikingly different from any other in the subsection. It is readily distinguished by the elevated veins, forming a conspicuously reticulate pattern on the lower surface of the leaves and bracts, and by the beakless seeds (i.e. lacking an elevated hilum); in addition, the bracts and the pistillate sepals become unusually large and foliaceous especially in fruit.

I have not seen pistillate flowers of this species but Mueller described them as being separate and internally villous while McVaugh states them to be "connate up to half their length" and furthermore to be "entirely glabrous." The problem as to whether the petals of the pistillate flowers of the species of this subsection are separate or united has been a most perplexing one and one that is not yet conclusively settled. The corollas of *J. curcas* and *J. pseudo-curcas* have always been interpreted, I believe, as being gamopetalous in both sexes. It appears to me that in all cases the "tube" is merely the result of the densely interwoven or entangled villous inner surfaces of the petals which seem imbricate to the very base of the flower. The corollas appear, after an admittedly superficial and unsatisfactory study, to be polypetalous in the five species studied. This character is a most vexing one to attempt to determine from dried specimens and a correct interpretation is made even more difficult by the paucity of mature flowers.

5. **Jatropha bartlettii** sp. nov.*

Monoecious much-branched tree about 7 m. high. The trunk with a diameter of about 2 dm. and the wood soft. Pith hollow in the older parts of the twigs, homogeneous and brown in the younger growth. Exudate cloudy-white when fresh but drying dull reddish-brown. Branchlets while young densely covered with short tawny pubescence. Petioles (even when mature) densely tawny pubescent, 6–10 cm. long, 2–3 mm. in diameter. Stipules filiform, up to 1 cm. long, tawny tomentose. Leaves more or less orbicular in outline, palmately 3–7-lobed, texture drying heavily chartaceous, 12–20 cm. long and usually somewhat broader, lower surface densely white-tomentose except for the often tawny-tomentose pubescence of the principal veins, upper surface glabrous at maturity except the often tawny pubescent larger veins and the conspicuously and densely white pubescent leaf-margin. Principal veins extending as glandular knobs about 1 mm. beyond blade. Inflorescence bisexual but usually either largely staminate

* **Jatropha bartlettii** sp. nov. Arbor monoica circa 7 m. alta et 2 dm. diam. Folia crassa, in speciminibus siccis crasse chartacea, subtus dense albido-tomentosa, supra paene glabra; venae maximae fulvo-tomentosae, mucrones nudos extra laminam circa 1 mm. longos extendentes. Inflorescentiae bisexuales sed plerumque per maximam partem masculinae vel foemineae, ramo infimo singulo; inflorescentia foeminea subcapitata, inflor. masculina laxe corymboso-cymosa. Calyx utriusque sexus obscure glanduloso-dentatus et imbricatus; sepala masculina scariosa, foeminea herbacea. Corolla intus villosa. Stamina 10, biverticillata. Styli 3, inferne connati; stigmata vix bifida subglobosa. Fructus et semina ignota.

or pistillate. Peduncles axillary, tawny pubescent, 3–15 cm. long, 2–4 mm. in diameter. Pistillate inflorescence compact 2.5–6 cm. broad, cymosely subcapitate, bracts foliaceous, 1–2 cm. long, 0.8–1 cm. wide. Staminate inflorescence loosely corymbose-cymose, 8–15 cm. broad, bracts scale-like, 3–5 mm. long and about 1 mm. wide, tawny pubescent. Inflorescence branches alternate below but becoming opposite above.

Staminate flowers: Sepals 5, imbricate, scarious, united into tube for about one-third their length, broadly ovate to oblong, 2.5–3.5 mm. long, 1.5–2.5 mm. wide, bearing about 4–6 irregularly spaced, shortly stipitate to sessile, minute, tooth-like glands near the apex and externally short, somewhat curly, scattered hyaline hairs. Petals 5, separate, imbricate, 4–5 mm. long, 2–3 mm. wide, greenish-white, densely long villous within, externally glabrous. Staminodial glandular-knobs at base of stamineal column 5, finger-like, slender, 1–1.5 mm. long. Androecium 4–6 mm. high, the anthers 10 in verticils of 5, 1–1.2 mm. long; the filaments of lower verticil becoming free from the column about 2 mm. above the receptacle and about 2 mm. long, the filaments of upper verticil separating about 4 mm. from base of column and about 1.5 mm. long; filaments, especially of the upper verticil, conspicuously villous.

Pistillate flowers: Sepals 5, unequal, herbaceous, imbricate, ovate to oblong, 6–12 mm. long, 2–12 mm. wide, densely tomentose externally, glabrous or nearly so within, with irregularly spaced stipitate glands along the margin. Petals 5, separate, imbricate, oblong-elliptic, 6–12 mm. long, 3–5 mm. wide, greenish-white, densely pale-tawny villous within, glabrous or nearly so without, longer than the sepals at anthesis by the 1.5–2 mm. reflexed tip. Staminodial lobes 5, flat, obtuse, broadly oblong, noncontiguous, apparently glandular, 1.5–2 mm. long, about 1 mm. wide. Ovary tricarpellate and about 3 mm. high. Style united for about 3 mm. then trifurcating with branches about 1.5 mm. long each terminated by a barely 2-cleft, knob-like stigma. Mature fruit and seed unknown.

TYPE: Heavily forested slopes at an altitude of about 5500 ft. about 12 mi. s.s.w. of Autlán, Jalisco, Mexico. July 2, 1949. *R. L. & C. R. Wilbur 1472* (MICH). Several isotypes are to be distributed.

This species, although known only from the type-collection, is readily distinguished by numerous features. The leaves have a heavy texture, a densely matted, chalky-white pubescent lower surface, an almost glabrous upper surface but with a densely white pubescent margin, and the veins extend beyond the blade as peg-like projections. This combination of features is not found in any other species in the subsection. *J. bartlettii* is readily recognizable by its foliage alone. The excurrent nature of the veins provides another feature which is unique among the species of this subsection. The stigmatic structure of *J. bartlettii* is also diagnostic, the style-branches being terminated by knob-like, scarcely creased stigmas which contrast strongly with those of the other species in subsection *Eucurcas*. In the other species, the stigmas are deeply bifid or bifurcated into fleshy lobes more than 1 mm. long. I have not seen the stigmas of *J. andrieuxii* but they are reported by McVaugh to be "bifurcated, but slender, apparently lacking the fleshy stigmatic lobes characteristic of *Mozinna*."

The plant from which the type specimens were obtained grew just below the crest of a densely forested mountain between the valley of Autlán and the lowlands about the town of La Resolana. It was the only plant of that species that I can remember seeing in the area. The slopes upon which it grew were often enveloped by clouds that veiled the view of the Pacific forty or so miles to the

southwest. This species is named for Professor H. H. Bartlett, Director of the Botanical Gardens of the University of Michigan, whose enthusiasm and knowledge of the Mexican Flora have not diminished through the years in spite of the ever-widening scope of his interests.

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RANGE EXTENSIONS IN THE FLORA OF NORTH CAROLINA—II

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This is a report of range extensions into North Carolina, extensions from one province into another within the state, and records of plants rarely collected in the state. Most of the citations in this paper are from my collections of 1952 and 1953. Distribution data are based on specimens deposited in the herbaria of Duke University, North Carolina State College, and the University of North Carolina, and from information in recent publications. General range data, unless otherwise specified, are from "Gray's Manual of Botany," Fernald (1950), and "Manual of the Southeastern Flora," Small (1933). My collections are deposited in the Herbarium of the University of North Carolina. Other collections are found in herbaria as indicated in the citations.

Potamogeton illinoensis Morong

DARE CO.: *Fosberg* Oct. 13, 1940 (NCSC); *Radford, Haesloop, & Miller 7524.* Ogden (1943) recorded a collection by Godfrey from Orton Lake near Southport, N. C., but does not show it on his distribution map. Apparently Fosberg and I collected it from the same fresh water pool on Cape Hatteras in Dare Co., where it is now abundant, making this the second locality for N.C.

Naias gracillima (A. Br.) Magnus

WASHINGTON CO.: *Radford, Haesloop, & Miller 7665.* This species has been recorded from the mountains and the piedmont (Radford, 1950). Our Washington Co. collection is the first from the coastal plain.

Glyceria septentrionalis Hitchc.

MADISON CO.: *Radford & Haesloop 7289.* This species is very abundant in a floodplain marsh on the French Broad River in the mountains. It was previously reported from the outer piedmont and the coastal plain by Blomquist (1948).

Carex austro-caroliniana Bailey

HAYWOOD CO.: *Radford & Wood 6208;* SWAIN CO.: *Radford & Haesloop 7224.* These are the first records in the local herbaria from this state. The Swain Co. collection was determined by Blomquist. According to Small this species grows in S.C., Tenn., and N.C.

Zigadenus glaucus Nutt.

MCDOWELL CO.: *Radford 6353.* This widely distributed species is reported from w. N.C. by Fernald, Small, and Gleason (1952), but this is the first collection in the state herbaria.

Nemexia biltmoreana Small

GASTON CO.: *Radford & Haesloop 7080.* This species is reported by Small from the Blue Ridge and adjacent provinces of S.C. and N.C. Our collection is the first for the N.C. herbaria.

Dioscorea Batatas Dcne.

DURHAM CO.: *Coker* Oct. 15, 1950; CALDWELL CO.: *Radford & Radford 6253.* In Caldwell Co. this weed seemed well established on the roadside and adjacent hillside. These are the only N.C. specimens I have seen.

Hexalectris spicata (Walt.) Barnh.

JONES CO.: *Radford, Haesloop, & Miller 7325.* There are several previous records from the mountains and piedmont regions of N.C., (Correll, 1937). Our collection is the first coastal record.

Parietaria pennsylvanica Muhl.

MADISON CO.: *Correll 3781* (DUKE); *Radford & Haesloop 7279.* According to Fernald and Small this species is widely distributed throughout the e. U.S., but it has not been reported from N.C. prior to the present publication.

Polygonum Careyi Olney

DARE CO.: *Radford, Haesloop, & Miller 7635.* Fernald reports the species as far s. as Del., and Small records it from Fla. Ours is the first N.C. record.

Silene Cucubalus Wibel.

BUNCOMBE CO.: *Fox & Beaman 4792* (NCSC); WILKES CO.: *Radford & Radford 6697.* This is a widely distributed weed which Fernald has reported as far s. as Va. and Tenn.

Delphinium tricorne Michx.

BUNCOMBE CO.: *Radford, Wood, & Taylor 6944.* Gleason reports the species from N.C., but this is the first specimen from the state in the local herbaria.

Anemone caroliniana Walt.

ORANGE CO.: Numerous collections have been made from Morgan's Creek since 1888, apparently from the same colony. This is a central U.S. species that ranges as far n. along the Atlantic seaboard as N.C. The species was not reported from the piedmont by Blomquist and Oosting (1953).

Lepidium perfoliatum L.

SAMPSON CO.: *Westmoreland* (NCSC); WAKE CO.: *Sheets* Apr. 10, 1952 (NCSC); ORANGE CO.: *Radford 6031.* This w. and n. w. weed has been reported only as far s. as Pa.

Philadelphus inodorus L.

ORANGE CO.: *Radford & Haesloop 6979.* Gleason and Small list it from the mountains of N.C. Our piedmont collection is the only specimen in the herbaria of the state.

Peplis diandra Nutt.

WAKE CO.: *Lewis* May 1943 (NCSC); CHOWAN CO.: *Radford, Haesloop, & Duke 6540.* Previous records in the manuals of the flora of the e. U.S. were based on R. E. Coker's Moore Co. collections. The plants at this station have disappeared, and the only definitely known living plants in N.C. are located on a small stream near Yeopim in Chowan Co.

Panax trifolium L.

ORANGE CO.: *Holmes* Apr. 25, 1888; *Totten* Apr. 16, 1930. Blomquist and Oosting do not list this species from the piedmont. It is infrequent in the mountains.

Gaylussacia dumosa (Andr.) T.&G.

HENDERSON CO.: *Memminger* May 30, 1886; *Correll, Blomquist, & Garren 5143* (DUKE); TRANSYLVANIA CO.: *Radford 6090.* These collections extend the range into the mountains of N.C. The Transylvania collection was growing in very thin soil over rock, under xerophytic conditions. In the s.e. its range is mostly on the coastal plain.

Gratiola aurea Muhl.

GATES CO.: *Correll 2230* (DUKE); SAMPSON CO.: *Correll 1277* (DUKE); PENDER CO.: *Radford, Haesloop, & Miller 7389.* Pennell (1935) gives its distribution from Nfld. to N.D. and Fla., but does not cite a specimen from N.C.

Plantago cordata Lam.

STANLEY CO.: *Radford & Haesloop 7071*. This is the only specimen in our local herbaria. Fernald gives its distribution as sporadic in the central U.S. and on the Atlantic coast.

Verbesina virginica L.

SWAIN CO.: *Radford & Duke 6505*. Ours is the first N.C. record in the state herbaria. Fernald reports it from Fla. to Tex. n. to Pa., Ky., Mo., and s.e. Kans.

Xanthium spinosum L.

HENDERSON CO.: Campbell; HYDE CO.: *Radford, Haesloop, & Duke 6638*. This is the first record in the state herbaria of this widely scattered weed.

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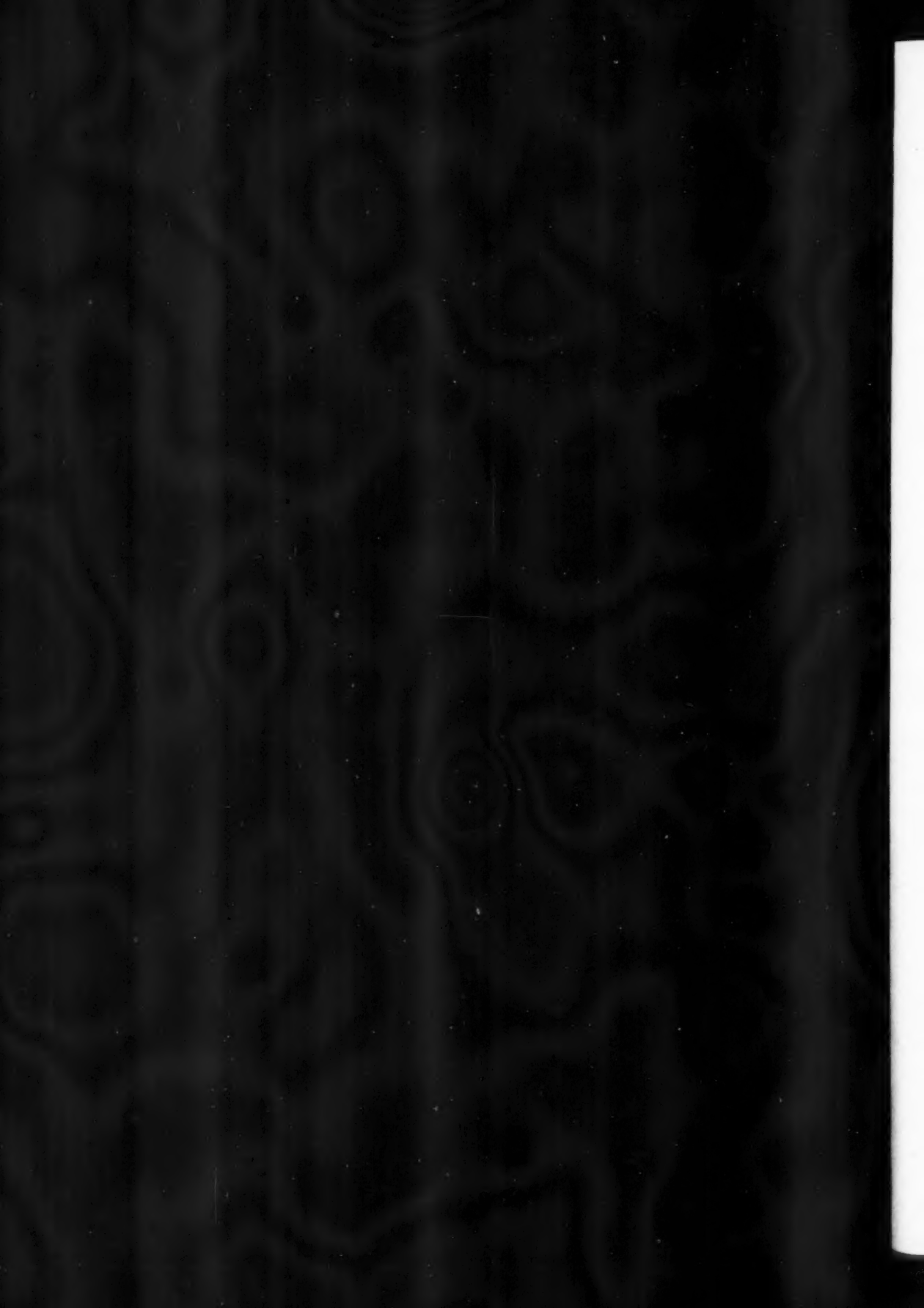

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(5) BRAUER, A., AND N. MACON. Amer. Jour. Math. **71**: 349–361. 1949.

BAILEY, JOSEPH R., AND DAVID G. FREY. 1951. Darters of the genus *Hololepis* from some natural lakes of North Carolina. Jour. Elisha Mitchell Sci. Soc. **67**: 191–203.

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